U. S. DEPARTMENT OF AGRICULTURE.

NINETEENTH ANNUAL REPORT

OF THE

BUREAU OF ANIMAL INDUSTRY

FOR

THE YEAR 1902.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1903.

[PUBLIC—No. 15.]

AN ACT providing for the public printing and binding and the disposition of public documents.

SEC. 73. Extra copies of documents and reports shall be printed promptly when the same shall be ready for publication, and shall be bound in paper or cloth, as directed by the Joint Committee on Printing, and shall be the number following in addition to the usual number.

Of the report of the Bureau of Animal Industry, 30,000 copies, of which 7,000 shall be for the Senate, 14,000 for the House, and 9,000 for distribution by the Agricultural Department.

Approved, January 12, 1895.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., April 10, 1903.

SIR: I have the honor to submit herewith the Nineteenth Annual Report of the Bureau of Animal Industry, prepared in accordance with the organic act creating the Bureau, and recommend that it be forwarded to the Public Printer for printing.

Respectfully,

D. E. SALMON,
Chief of Bureau.

HON. JAMES WILSON,
Secretary.

ORGANIZATION OF THE BUREAU OF ANIMAL INDUSTRY.

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Zoological division: CH. WARDELL STILES, M. S., A. M., Ph. D., consulting zoologist in charge.

EXPERIMENT STATION.

Superintendent: E. C. SCHROEDER, M. D. V.; expert assistant, W. E. COTTON.

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MEAT INSPECTION.

The inspection of cattle, sheep, calves, and hogs and their products was conducted at 154 abattoirs and packing houses in 49 cities. Inspection was begun at 12 establishments—10 in cities where it was already in operation and 2 in two other places. The net decrease of 2 cities and 2 abattoirs is due to the withdrawal of inspection owing to the cessation of business or to its restriction to local trade. Horses were inspected at one other abattoir.

The following table shows the number of establishments and cities where inspection has been conducted:

Number of establishments and cities where inspection was conducted, 1891 to 1902.

Fiscal year.	Number of establishments.	Number of cities.	Fiscal year.	Number of establishments.	Number of cities.
1891	9	6	1897	128	33
1892	28	12	1898	135	35
1893	37	16	1899	139	42
1894	46	17	1900	149	46
1895	55	19	1901	157	52
1896	102	26	1902	155	50

The accompanying table shows the number and kinds of animals inspected before slaughter and the number of these that were rejected for some cause apparently unfitting them for food purposes, the final condemnation or passing of the carcass depending upon the result of the post-mortem inspection.

Antemortem inspections for the fiscal year 1902.

Kind of animal.	For official abattoirs in cities where inspections were made.	For abattoirs in other cities and miscellaneous buyers.	Total inspections.	Rejected (subject to result of postmortem inspection).	
				At abattoirs.	In stock yards.
Cattle	5,733,698	4,062,752	9,796,450	340	41,657
Sheep	7,497,738	5,059,054	12,556,792	1,180	15,633
Calves	515,442	323,785	839,227	1,259	4,240
Hogs	25,096,684	10,867,846	35,964,530	3,576	63,736
Horses	1,649		1,649		
Total	38,845,211	20,313,437	59,158,648	6,355	125,266

There was an increase of 1,919,502 in the number of animals inspected for official abattoirs, horses only showing a slight decrease, and an increase of 2,789,338 in the total number of inspections.

The inspection of animals at time of slaughter, with the number of carcasses and parts of carcasses condemned and tanked, is shown in the following table. The number of condemnations for trichinosis is given under the head of "Microscopic inspection of pork."

Postmortem inspections for the fiscal year 1902.

Kind of animal.	Number of inspections.			Carcasses condemned.			Parts of carcasses condemned.
	For official abattoirs.	On animals rejected in stock yards.	Total.	For official abattoirs.	Animals rejected in stock yards.	Total.	
Cattle	5,559,969	29,722	5,589,691	10,599	3,684	14,283	3,414
Sheep	7,434,878	9,075	7,443,953	4,020	2,790	6,810	71
Calves	555,836	715	556,551	125	445	570	26
Hogs	25,277,107	34,674	25,311,781	35,821	4,471	40,292	13,934
Horses	1,649		1,649	25		25	
Total	38,829,439	74,186	38,903,625	50,590	11,390	61,980	17,445

In addition to the carcasses condemned as above and to those condemned for trichinosis, the table below shows the number tanked for other reasons—bodies of dead animals taken from cars or pens at abattoirs, or animals that, after inspection in the stock yards, had died from disease or injury or were killed by municipal inspectors:

Manner of death.	Cattle.	Sheep.	Calves.	Hogs.	Horses.	Total.
Died in stock yards	312	1,036	151	3,273		4,772
Killed in stock yards	189	26	5	10,802		11,022
Died at abattoirs	299	1,323	195	10,959	48	12,824
Total	800	2,385	351	25,034	48	28,618

Below is shown a statement of the total number of carcasses and parts condemned and tanked, with the causes of condemnation, at the time of slaughter, and including the carcasses of animals found dead and those killed by city inspectors:

Causes of condemnation of carcasses and parts of carcasses, fiscal year 1902.

Cause of condemnation.	Cattle.		Sheep.		Calves.		Hogs.		Horses.
	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.
Actinomycosis	1,264	652			4		36	38	
Tuberculosis	7,944	152	26		13		14,927	4,700	
Caseous lymphadenitis			978	1					
Cholera and swine plague							16,989		
Texas fever	157				36				
Echinococcus	1		4				1	74	
Measles							10		
Scabies			15				52		
Eczema							8		
Erysipelas							25		
Cancer	42		3				11		
Tumor	20	1	3	2	1		411	685	
Abscess	108	1,530	50	4	10	5	626	1,792	1
Pneumonia	141		235		10		744		
Pleurisy	8		11	1			58	21	
Carditis	1								
Enteritis	28		64		3		263		1
Peritonitis	152		58		26		445		1
Metritis	21		14				135		
Nephritis	4		14		1		26		
Uremia			18				20		
Mammitis			2				5	327	
Septicemia	179		128		14		623		12
Pyemia	250		103		9		1,830		1
Gangrene	4		3		2		27		
Anemia, emaciation, marasmus	2,791		3,632		66		573		3
Ascites and anasarca	19		49				44		
Jaundice	9		190		2		673		1
Extreme temperature, various causes			47		7		1,106		1
Pregnancy	75		36				350		
Recent parturition	16		6				50		
Hernia	3		8				15		
Downers, bruised, injured, etc	1,040	1,079	1,086	63	54	21	209	6,297	
Asphyxiation	6								
Impaction of rumen			1						
Distoma			7						
Sick			19						
Too young					311				
Melanosis					1				4
Dead from various causes	611		2,359		346		14,232		48
Killed by city inspectors	189		26		5		10,802		
Total	15,083	3,414	9,195	71	921	26	65,326	13,934	73

The following table, showing for the fiscal years 1891 to 1902 the total number of animals inspected at time of slaughter for abattoirs having inspection, is given for the purpose of comparison:

Number of animals inspected at slaughter for abattoirs having inspection, fiscal years 1891 to 1902.

Fiscal year.	Cattle.	Calves.	Sheep.	Hogs.	Horses.	Total.
1891	83,889					83,889
1892	3,167,009	59,089	583,361			3,809,459
1893	3,922,079	92,947	870,512			4,885,538
1894	3,861,594	96,331	1,020,764	7,648,146		12,626,835
1895	3,704,042	116,093	1,428,601	13,616,539		18,865,275
1896	3,985,484	256,905	4,629,796	14,250,191		23,122,376
1897	4,242,216	273,124	5,209,161	16,808,771		26,533,272
1898	4,418,738	244,330	5,496,904	20,893,199		31,053,171
1899	4,382,020	246,184	5,603,096	23,836,943	3,332	34,071,575
1900	4,841,166	315,693	6,119,886	23,336,884	5,559	34,619,188
1901	5,219,149	413,830	6,639,212	24,642,753	1,992	36,916,936
1902	5,559,969	555,836	7,434,878	25,277,107	1,649	38,829,439

The meat-inspection tag or brand was placed upon 19,694,665 quarters, 250,141 pieces, and 3,820 sacks of beef; 7,419,287 carcasses of sheep, 554,016 carcasses of calves, 1,253,083 carcasses of hogs, and 793,471 sacks of pork.

The meat-inspection stamp was affixed to packages of meat products that had received the ordinary inspection as follows: 7,166,490 of beef, 39,229 of mutton, 8 of veal, 15,835,520 of pork, and 638 of horseflesh, a total of 23,041,885.

The number of cars sealed containing inspected meat products for shipment to official abattoirs and other places was 64,730.

The number of certificates of ordinary inspection issued for meat products for export, exclusive of horseflesh, was 32,744. Of beef, there were 1,571,305 quarters, 19,728 pieces, 3,845 bags, and 1,582,549 packages, with a weight of 416,990,762 pounds; of mutton there were 85 carcasses and 26,942 packages, weighing 1,145,248 pounds; of pork there were 94,962 carcasses and 658,139 packages, weighing 188,360,011 pounds. These figures show a decrease from the previous year of 35,839,611 pounds of beef and 42,784,927 pounds of pork.

There were 11 certificates issued for horseflesh, the export consisting of 638 packages, weighing 170,968 pounds.

The accompanying table shows for several years the quantities of beef, mutton, and pork for export which received the certificates of inspection, not including microscopically examined pork.

Expenditures on account of the statement below amounted to $638,592.79. The cost of each of the 59,158,648 antemortem inspections averaged 1.08 cents.

Quantities of beef, mutton, and pork for export upon which certificates of ordinary inspection were issued, 1898 to 1902.

Fiscal year.	Beef.	Mutton.	Pork.
	Pounds.	*Pounds.*	*Pounds.*
1898	339,650,091	324,996	244,956,482
1899	360,843,856	525,705	278,696,435
1900	438,138,233	680,897	272,050,663
1901	452,830,373	894,648	231,144,938
1902	416,990,762	1,145,248	188,360,011

The following shows the cost of each antemortem inspection from 1893 to 1902, inclusive:

	Cents.		Cents.
1893	4.75	1898	0.80
1894	1.75	1899	.88
1895	1.10	1900	.95
1896	.95	1901	1.01
1897	.91	1902	1.08

MICROSCOPIC INSPECTION OF PORK.

The number of carcasses examined was 681,865, classified as follows: Class A (free of all appearance of trichinæ), 664,288, or 97.42 per cent; Class B (containing trichina-like bodies or disintegrating trichinæ), 10,085, or 1.48 per cent; Class C (containing living trichinæ), 7,492, or 1.10 per cent.

During the first half of the year livers were examined separately from the carcasses, and 350,800 examinations were made. The number of livers so examined was 892,191, of which 869,073 were in Class A and 23,118 in Class C. As three livers were usually examined at one time, and all were condemned if trichinæ were found in the preparation, the number in Class C does not indicate the actual number infested.

There were 7,481 trichinous carcasses, weighing 1,585,627 pounds, and 68,801 pounds of livers disposed of during the year. About one-half was tanked and the rest made into cooked meat.

The number of certificates issued for microscopically inspected pork products for export was 5,613; the number of packages stamped and exported was 95,508, with a weight of 33,681,229 pounds. The decrease in the exports amounted to 2,261,175 pounds.

The following shows the exports of pork to countries requiring certificates of microscopic inspection from 1892 to 1902:

	Pounds.		Pounds.
1892	22,025,698	1898	120,110,356
1893	8,059,758	1899	108,858,149
1894	18,845,119	1900	55,809,626
1895	39,355,230	1901	35,942,404
1896	21,497,321	1902	33,681,229
1897	42,570,572		

The cost of the microscopic inspection was $123,947.31. This is an average of 12 cents for each examination and 0.368 cent for each pound exported.

INSPECTION OF VESSELS AND EXPORT ANIMALS.

The number of certificates of inspection issued for American cattle exported to Europe was 1,102; the number of clearances of vessels carrying inspected live stock was 837. The figures show a falling off in the exports of American animals, there being 91,336 cattle, 16,710 sheep, and 13,985 horses fewer than during the previous year. The number of Canadian cattle and sheep exported from United States ports was increased. All of the animals in the following table were exported to Great Britain with the exception of 301 cattle, 200 sheep, and 412 horses to Belgium, 198 sheep to France, and 124 horses to Germany.

Number of inspections, etc., of American and Canadian animals, fiscal year 1902.

Kind of animal.	American.				Canadian.		
	Inspections.	Rejected.	Tagged.	Exported.	Inspected.	Rejected.	Exported.
Cattle	584,040	1,491	304,441	[a] 293,386	72,726	47	72,679
Sheep	401,132	266	----------	[b] 211,224	52,445	74	52,371
Horses	19,990	86	11,272	[c] 10,967	337	2	335

[a] 7,904 via Canada. [b] 280 via Canada. [c] 80 via Canada.

In addition, there were inspected for export to other countries 1,960 cattle, 954 sheep, 8 horses, and 21 mules, as follows: Bermuda, 1,854 cattle, 714 sheep, 7 horses; Brazil, 34 cattle; Africa, 45 cattle, British Guiana, 80 sheep; Barbados, 160 sheep; Jamaica, 21 mules, 1 horse; Costa Rica, 10 cattle; Newfoundland, 17 cattle.

The number of American and Canadian animals landed alive at the foreign-animals wharves in London, Liverpool, and Glasgow, and inspected by inspectors of this Bureau stationed at these ports, together with the number and percentage lost in transit, is shown in the following table:

Number of animals inspected at time of landing in London, Liverpool, and Glasgow, and loss in transit, fiscal year 1902.

From—	Cattle.			Sheep.			Horses.		
	Landed.	Lost.		Landed.	Lost.		Landed.	Lost.	
	No.	*No.*	*Per cent.*	*No.*	*No.*	*Per cent.*	*No.*	*No.*	*Per cent.*
United States	284,339	378	0.13	211,617	1,890	0.89	10,869	71	0.65
Canada	65,343	153	.23	49,679	881	1.74	295	6	1.99
Total	349,682	531	.15	261,296	2,771	1.05	11,164	77	.68

INSPECTION OF IMPORTED ANIMALS.

The numbers and kinds of animals imported from Mexico and inspected at ports of entry along the international boundary line are shown in the table following:

Importation of Mexican animals, fiscal year 1902.

Port of entry.	Cattle.	Sheep.	Lambs.	Asses.	Horses.	Mules.	Goats.	Hogs.
Eagle Pass, Tex	292				5	10	1,736	
El Paso, Tex	43,021				3	26		
Nogales, Ariz	20,550			9			114	64
San Diego, Cal	1,350	2,703	1,073	6			240	
Total	65,213	2,703	1,073	15	8	36	2,090	64

There were also inspected animals imported in bond as follows: At Nogales, 640 cattle, destined to Lower California; at El Paso, 3,622 cattle, 26 horses, 4 mules, and 2 asses, destined to Canada.

Through ports on the seacoast, animals not subject to quarantine were imported as follows:

From—	Horses.	Ponies.	Mules.	Zebra.	Water buffaloes.	Bears.	Monkey.	Dogs.
Europe	2,206	58	11	1				
Bermuda	13							
Porto Rico	1	2						
Cuba	11							
Mexico	4		1					
South America	1							
Algiers			1					
Manila	2				4			
China	3							
Canada	42		1					2
New Zealand						4		
Ceylon							1	
Total	2,283	60	14	1	4	4	1	2

A statement of other animals imported through ports along the Canadian border and through quarantine stations on the Atlantic coast will be found in the report of the "Miscellaneous division."

CONTROL OF CONTAGIOUS DISEASES.

Southern cattle inspection.—The supervision of the movement of cattle from the area quarantined on account of Southern, or Texas, or splenetic, fever of cattle, due to the presence of the tick (*Boophilus annulatus*) which carries the infection, involved the proper yarding in the quarantine divisions of the different stock yards of 1,126,490 head of cattle during the quarantine season of 1901. To transport these cattle required 42,354 cars, each of which had to be placarded, and all of the waybills, manifests, and bills of lading accompanying

the shipments had to state that the cattle were Southern cattle. The number of cars cleaned and disinfected was 46,736.

In Texas 418,566 cattle were inspected and identified by brands as originating outside of the quarantined district and were permitted to be moved for grazing to Northern States.

Scabies in sheep.—The number of sheep inspected in stock yards, at feeding stations, and at many places throughout the West, in order to prevent the shipment of sheep affected with or that had been exposed to scabies, amounted to 11,186,661. The number of sheep dipped under the supervision of Bureau inspectors was 1,017,162. The number of cars cleaned and disinfected was 791. For shipments of sheep that were found free of infection certificates of inspection were given.

BIOCHEMIC DIVISION.

The routine work of this division in the preparation and shipment of tuberculin and mallein has been continued. Large quantities of tuberculin have been shipped, and a large amount of mallein has been supplied, especially to the War Department and to State officials entitled to receive it. According to the records, about 55,000 doses of tuberculin have been sent out to 33 different States and 12,000 doses of mallein to 25 different States. During a portion of the year stamping ink for meat has been prepared and 312 gallons shipped.

A limited amount of tetanus antitoxin has been prepared in conjunction with the experiment station of the Bureau. A great deal of work has also been done in connection with a comparative study of the tuberculosis germs from various sources. The virulence of the bovine germ for monkeys has been established and a preliminary note on this work published. Our work was the first recorded to show that the bovine germ was pathogenic for monkeys. A number of different varieties of the tubercle germ have been obtained from children and adults in the various hospitals of Washington City, and their morphological and cultural characteristics and virulence for small animals, as well as cattle, have been and are being tested.

A very valuable piece of work has been done by Dr. M. Dorset, assistant chief of the division, in suggesting the use of a solid medium for cultivating the tuberculosis germ, namely, the substitution of egg for blood serum. The great ease with which this can be prepared and the very satisfactory character of the results obtained make this work of great importance. In addition to this, there has been published a chemical analysis of tubercle bacilli derived from various animals. This laboratory was the first to publish, some years ago, a report upon a complete chemical analysis of the tuberculosis germs of human origin. The work above referred to, which is a continuation of this line of investigation, includes, in addition to the germs of human origin, those derived from the horse, hog, cow, birds, and dogs. The results of these comparative analyses are of importance, not only in corroborating our suppositions that the composition of the various tubercle

bacilli is influenced by their surroundings, but also in indicating other points for further investigation in connection with the treatment of this disease.

The experiments in connection with hog cholera and swine plague have also been continued, both at the Experiment Station of the Bureau and in the West. Progress has been made and new factors of importance discovered. The feeding experiments of poultry have been continued and the results of the work are about ready for publication. A number of routine examinations of various sorts in connection with the work of the Bureau have also been made.

It is proposed during the coming year to continue the routine work above noted, and also the investigations already started, and to begin as many others as the facilities of the laboratory will allow.

DIVISION OF PATHOLOGY.

The most important branches of work upon which this division has been engaged during the past fiscal year are the following:

(1) The investigation of a fatal infectious disease of chickens, to which the name of "apoplectiform septicemia" has been given.

(2) The preparation for publication of the results obtained in the investigation relative to "the infectiveness of milk from cows which have reacted to the tuberculin test."

(3) An investigation concerning the comparative virulence of tubercle bacilli from human, bovine, ovine, porcine, and simian sources.

(4) An investigation of a highly fatal enzootic among the cattle in a dairy herd in the vicinity of the city of Washington.

(5) A preliminary study of a progressive, chronic, but nevertheless fatal disease among Angora goats, which has been brought to our attention from Massachusetts, Pennsylvania, Maryland, Virginia, and Missouri.

(6) An investigation of the so-called maladie du coït among horses in Nebraska, with particular reference to the probability of its ultimate extirpation.

(7) The preparation and distribution of blackleg vaccine.

(8) A continuation of the inoculation experiments and microscopic examinations for the purpose of determining the prevalence of rabies in the District of Columbia.

(9) The preparation of tubes of grasshopper disease fungus for distribution by the Division of Entomology.

(10) Experiments relative to the preparation of a harmless but efficient anthrax vaccine.

(11) The preparation, installation, and supervision of a pathological exhibit at Buffalo, N. Y., and Charleston, S. C.

(12) The determination of pathological specimens sent to the Bureau for diagnosis and the preparation of answers to inquiries relative to the character, cause, and treatment of various diseases of domestic animals.

APOPLECTIFORM SEPTICEMIA IN CHICKENS.

A highly fatal disease in chickens, to which the name "apoplectiform septicemia" has been applied, was observed on a farm in northern Virginia during the past year. The nonpyogenic streptococcus isolated as the causative agent in the outbreak is possessed of unusual virulence for chickens, causing sudden death without premonitory symptoms and with a mortality of 100 per cent of those affected and 92 per cent of the entire flock. The nature, etiology, and prevention of this affection have been studied and the results of the investigation published as Bulletin No. 36 of this Bureau.

INFECTIVENESS OF MILK FROM TUBERCULOUS COWS.

As a result of the elaborate experiment which was conducted in this laboratory for the purpose of establishing the presence or absence of the tubercle bacilli in the milk of tuberculous cattle, a paper has been prepared entitled "Infectiveness of milk from cows which have reacted to the tuberculin test."[a] This paper contains the final results obtained from the inoculation and ingestion experiments conducted upon guinea pigs with the milk of the tuberculous cows at the Government Asylum for the Insane, together with the positive findings recorded in 57 similar experiments made by competent investigators in this and foreign countries. This experiment lasted ninety days and included the milk of 56 tuberculous cows. A synopsis of the results shows that one or more of the guinea pigs fed with milk from 9 different cows have succumbed with typical tuberculosis; that is, the milk of 16.1 per cent of the 56 reacting cows has been found to be pathogenic to guinea pigs when fed to them. Of the experiment animals inoculated intraabdominally, in the first series at least, 1 guinea pig has died of tuberculosis in each of 6 different instances, showing that the milk of 10.7 per cent of the 56 reacting cows in this experiment has proved fatal to guinea pigs in the first inoculation experiment. In the second series of intraabdominal injections the milk from 7 individual cows out of 45 examined, or 15.5 per cent, was demonstrated to possess virulent tubercle bacilli. By uniting these inoculation results it will be observed that 11 out of 56 cows, or 19.6 per cent, secreted milk which transmitted tuberculosis to one or more experiment animals when injected into the peritoneal cavity.

Owing to the greater percentage of positive results obtained from the second inoculation experiment, conducted more than two months after the first intraabdominal test, it appears probable, as would be expected, that the virulence of the milk increased with the advancement of the disease in the cow. The lack of uniformity of results obtained in many of the cows might be explained from our knowledge that tubercle bacilli are not excreted by the normal udder with any

[a] Published as Bulletin No. 44, Bureau of Animal Industry.

degree of constancy. For this reason the continuous feeding experiment, covering a period of three months, seems to have more practical value in demonstrating the transmission of tuberculosis than the inoculation test, where the only possibility of affirmative results must depend on the contingency of the accidental excretion of the bacilli on one particular day.

The combined results of the ingestion and inoculation experiments show that the milk of 12 out of 56 reacting cows, or 21.4 per cent, has at one time or another since the beginning of the experiment contained virulent tubercle bacilli.

Cover-glass preparations of the centrifugalized sediment of milk from 4 out of 55 cows, or 7.3 per cent, revealed the presence of the tubercle bacillus, and in two of these cases the centrifugalized cream was also found to possess this organism. In one case (cow No. 10) tubercle bacilli were demonstrated only by microscopic examination of the centrifugalized sediment. The number observed were very few—3 in one slide and but 1 in another—while the remaining 9 cover-glasses were apparently free from this bacillus. It appears singular that positive results were not obtained by the intraabdominal injection of this sediment from which the cover-glasses showing the tubercle bacilli were made. Wyssokowitsch, in his experiments regarding the quantity of bacilli requisite for the production of tuberculosis by injection into the peritoneal cavity, found that it required at least 30 bacilli for the transmission of the disease. Granting this conclusion, it is evident that the milk injected either did not contain a sufficient number of bacilli to cause the disease or that the bacilli were less vigorous or the guinea pigs more resistant than in the other experiments. It is also of interest to know that of the guinea pigs that succumbed to tuberculosis as a result of intraabdominal inoculations, 7 were injected with a mixture of milk and cream, 5 with centrifugalized cream alone, and the remaining 8 with the milk sediment.

COMPARATIVE STUDY OF TUBERCLE BACILLI FROM VARIOUS SOURCES.

In view of the widespread interest now manifested concerning the intercommunicability of bovine and human tuberculosis, this line of investigation has been inaugurated, and a comparative study is at present being made of tubercle bacilli isolated from the mesenteric glands of a sheep, hog, cow, and 4 children, as well as those from the sputum and from the lung of a spontaneous case of tuberculosis in a monkey. The result of this investigation will be published as soon as the work has been completed.

ENZOOTIC AMONG DAIRY CATTLE.

An outbreak of a disease among the cattle on a dairy farm in this vicinity was brought to the attention of the Bureau last November by a local practitioner who requested consultation. The affection was

accompanied by certain symptoms and postmortem changes which apparently were dissimilar to any that have hitherto occurred in this locality. Owing to the proximity of the laboratory and the probability of the disease being at times existent but as yet unrecognized in other sections of the country, a thorough bacteriological examination was made, with the result that the etiological factor was found to be a bacillus of the enteriditis group. A paper on the subject is about completed which includes the results of this investigation, together with a comparison of allied organisms which have been isolated by Gaertner from the kidney and muscles of a cow; by Basenau from the organs of a cow which was supposed to have been suffering with parturient septicemia; by Foulerton from the muscle juice and kidney of an ox condemned as unfit for food, and by Thomassen from an outbreak which he describes as "a new septicemia of calves."

INFECTIOUS DISEASE OF ANGORA GOATS.

During the past winter information reached the Bureau from Massachusetts, Pennsylvania, Maryland, Virginia, and Missouri regarding the presence of a fatal disease affecting Angora goats. The common goat (*Capra hircus*) is popularly regarded as being immune from almost all diseases, but the appearance of an enzootic in several localities among well-bred Angoras seems to indicate either that this opinion is incorrect or that Angoras are more susceptible to disease than common goats. The economic importance of this affection becoming apparent from its virulence and the widespread points of infection, an official of the division was directed to make a complete investigation of the disease as it existed in Pennsylvania, with the view of discovering its etiology. A preliminary report on the nature and cause of this outbreak, including a comparison with probably a similar goat disease that has occurred in Saxony and Switzerland, will be ready for publication very soon.

ERADICATION OF THE SO-CALLED MALADIE DU COÏT.

The constant reappearance of this venereal disease among horses in Nebraska, after it apparently had been stamped out on several different occasions by inspectors of the Bureau detailed for this work, has occasioned a thorough investigation of the disease for the purpose of obtaining information regarding its latent qualities and other peculiarities, and incidentally to confirm, if possible, the work of Buffard and Schneider and Nocard regarding the etiological significance of the *Trypanosoma equiperdum*. This investigation is at present under consideration, but has not sufficiently progressed to warrant any conclusion at this time.

BLACKLEG VACCINE.

The demand for blackleg vaccine is gradually increasing as this method of preventive treatment becomes better known and its merits more widely heralded.

The number of doses of vaccine distributed during the past year and the results obtained in the previous year from its use may be more conveniently and vividly expressed by means of the appended tables:

Number of doses of vaccine distributed during fiscal year ended June 30, 1902.

July 1 to December 31, 1901:	
July	54,280
August	73,085
September	158,635
October	258,220
November	240,770
December	164,455
January 1 to June 30, 1902:	
January	144,230
February	92,800
March	145,960
April	162,785
May	112,570
June	80,775
Total	1,688,565

Results obtained from vaccine distributed during fiscal year ended June 30, 1902.

State or Territory.	Number of reports.	Number of cattle vaccinated.	Deaths same season previous to vaccination.		Died after vaccination.					Percentage of deaths after vaccination.
			Number.	*Per cent.*	Within 48 hours.	From 2 to 7 days after.	Within 1 year.	Number of cases due to mistakes.	Total number.	
Arizona	12	2,091	64	3.06	4	6	2	3	15	0.28
California	28	7,908	187	2.36	3	20	16	1	40	.43
Colorado	383	67,210	1,349	2.01	21	25	269	13	328	.44
Idaho	26	2,592	40	1.54	1		1	1	3	.04
Indian Territory	42	9,114	404	4.43	3	15	25	5	48	.44
Iowa	85	8,616	177	2.05	6	3	37		46	.47
Kansas	733	96,782	1,654	1.72	40	111	209	14	374	.30
Kentucky	23	1,458	37	2.54		1	4	6	11	.35
Minnesota	19	6,718	61	.91		1	26	1	28	.40
Missouri	162	18,649	483	2.60	5	8	40	21	74	.26
Montana	62	10,920	273	2.45	9	13	34		56	.43
Nebraska	944	92,990	3,076	3.31	53	82	395	4	534	.48
New Mexico	15	3,868	30	.78	2	5	2		9	.18
North Carolina	24	1,706	75	4.39	1	3	5		9	.47
North Dakota	266	39,168	1,064	2.72	11	17	118	3	149	.34
Oklahoma	141	23,408	939	4.09	4	19	69	4	96	.38
Oregon	19	3,456	108	3.12	1		1		2	.06
South Dakota	388	44,681	1,250	2.80	28	21	118	18	185	.31
Texas	430	90,788	2,020	2.22	48	144	467	6	665	.67
Utah	23	2,969	268	8.93		6	17	2	25	.77
Virginia	149	6,514	235	3.62	2	13	68		83	1.24
Washington	18	685	63	9.13	2	2	1	1	6	.44
West Virginia	42	1,556	41	2.62		4	4		8	.51
Wyoming	103	17,401	672	3.86	8	3	65	4	80	.38
Other States	52	4,380	247	5.64	4	14	9	1	28	.52
Total	4,192	565,628	14,817	2.62	256	536	2,002	108	2,902	.51

If we eliminate the number of animals that were probably infected before they were vaccinated, and which died within forty-eight hours after the injection, also the number of deaths that were acknowledged by the stock owners to be the result of their own mistakes, the number of cases that died after vaccination is reduced to 2,538, or 0.45 per cent.

RABIES.

During the fiscal year rabies continued to exist in the District of Columbia and adjacent sections. In consequence of inoculation tests and microscopic examinations made with the medulla and plexiform ganglion, respectively, of suspected cases, the following positive results have been obtained:

Results of inoculation tests and microscopic examinations for rabies.

Date.	Record number.	Source.	Animal inoculations.	Histological examination.	Persons bitten.	Animals bitten.
1901.						
July 19	202	Dog	Positive	None made.		
July 24	205	Dog	Positive	None made.	Boy	
Aug. 7	210	Dog	Positive	None made.		
Aug. 8	211	Dog	Positive	None made.		
Oct. 3	216	Dog	Positive	Positive	Girl	
Oct. 9	217	Dog	Positive	None made.	Man	
Oct. 14	218	Dog	Positive	Positive	Man and woman	3 dogs.
Nov. 29	220	Cow	Positive	None made.		
1902.						
Jan. 24	222	Dog	Positive	Positive	Woman	
Jan. 24	223	Dog	Positive	Positive		
Mar. 4	224	Woman	Positive	Positive		
Mar. 20	225	Dog	Positive	Positive		2 dogs.
Mar. 28	228	Dog	Positive	Positive		
Apr. 3	230	Cow	Positive	None made.		
Apr. 14	233	Dog	Positive	Positive		
Apr. 19	235	Dog	Positive	Positive	Man and child	
Apr. 22	236	Dog	Positive	Positive		
May 7	241	Horse	Positive	None made.		
May 14	243	Cow	Positive	None made.		
May 22	246	Dog	Positive	Positive		Several hogs.
May 31	247	Hog	Positive	None made.		
June 4	249	Dog	None made.	Positive		
June 13	250	Dog	Positive	Positive	Man	
June 18	252	Dog	Positive	Positive		Several dogs.
June 30	253	Dog	Positive	Positive		2 dogs.

GRASSHOPPER DISEASE FUNGUS.

The Division of Entomology has received the cooperation of this division during the past year in efforts directed toward the eradication of the destructive grasshopper. A fungus isolated from a number of grasshoppers that were found diseased in the vicinity of Sterling, Colo., has been distributed in subcultures to the farmers in the infected districts, together with other locust fungi which the Division of Ento-

mology obtained from South Africa. These molds have been kept alive in this laboratory, subcultures being furnished the Division of Entomology on request. During the past year over 780 tubes of fungi have been sent to 17 States in this country and some to several foreign countries.

EXPERIMENTS WITH PREVENTIVES FOR ANTHRAX.

Anthrax seems to be on the gradual increase in this country, and it would appear desirable for the Bureau to meet the great demand which has been constantly made by the cattle owners in the infected districts for a preventive against the disease. Anthrax vaccination has been adopted to some extent in certain districts, but in a more or less desultory manner, and the fact that it has not become more popular is probably due to the questionable efficiency of these vaccines. In order to test the relative value of both an active and a passive vaccine, various experiments have been conducted in the laboratory with attenuated bacilli cultures prepared after the method of Pasteur, and also with the serum of previously immunized animals following Sobernheim's and Sclavo's experiments. The comparatively small amount of vaccinal product obtained by the latter methods, the uncertain results which followed when virulent cultures were inoculated into animals that had been treated with the serum, and the necessity for meeting a large demand, should anthrax vaccine be distributed, have shown conclusively that Pasteur's method is preferable, even though it is necessary to handle the organism of anthrax by this method. These experiments have not been concluded, but it is believed that it will be possible without any great expense to meet the demand for this preventive treatment of anthrax by the beginning of the next anthrax season.

Owing to the susceptibility of man to this disease and the extreme care with which any active vaccine, the organism of which is virulent for man, must be handled, it would seem desirable to cooperate with the experiment station veterinarians, State and assistant veterinarians, or other State sanitary officers rather than to distribute the vaccine directly to the stock owner.

PATHOLOGICAL EXHIBIT.

Considerable time was devoted to the preparation, installation, and supervision of an exhibit at the Pan-American Exposition at Buffalo, N. Y., and the South Carolina Interstate and West Indian Exposition, at Charleston, S. C., representing the line of work of this laboratory and its practical application, especially to meat inspection and the preparation of blackleg vaccine.

DIAGNOSIS OF SPECIMENS AND ANSWERS TO INQUIRIES.

The amount of time that is required for this manner of work has been very great, and, while it does not appear to any great advantage

in a report of this nature, it has many beneficial results in disseminating important knowledge, and is greatly appreciated by those directly interested. During the past year there were 40,886 pieces of mail sent out by the division with reference to the distribution of blackleg vaccine.

ZOOLOGICAL DIVISION.

PUBLICATION OF THE CARD CATALOGUE.

Owing to repeated requests from various sources, and also to the risk of fire in the laboratory building, it was decided to undertake the publication of our card catalogue, which has been so long in preparation and which is invaluable. This has involved a great amount of work in verifying references which were copied from various authors and in making the abbreviations and style uniform. The "A" authors have already been issued, the "B" authors are in press, and the remaining authors are about ready for publication.

CONTINUATION OF EXPERIMENTS IN TREATING CATTLE, SHEEP, AND GOATS FOR ROUNDWORMS.

The experiments in this line have been highly successful, and the results of the work have already been published. The treatment with a 1 per cent solution of coal-tar creosote has been found to be the most satisfactory of any of the methods tried in cases of infection with free nematodes in the fourth stomach. This method entails only one-fourth to one-ninth the manual labor that is required when the gasoline treatment is used, and it seems to involve less risk of accident to the animals. The medicine itself, when made up in large quantities, costs less than one-half cent per dose. A recent letter from Dr. Peters, of the Nebraska Experiment Station, states that upon reading the Bureau's account of this method of treatment, he tested the same for roundworms in hogs and that it excels any other method known to him. The best results, in case of infection with free roundworms below the stomach, were obtained by combined doses of creosote and thymol. No success was obtained in attempting to treat cases of infection with roundworms encysted in the wall of the stomach or the intestine. All experiments with the most approved methods (intratracheal injections) of treating verminous bronchitis were also negative.

SURRA.

Owing to the diagnosis of surra among the army horses and mules in the Philippines, the Zoological Laboratory was suddenly called upon for an emergency report on this disease. An extensive report has been prepared and issued,[a] and it is hoped that its contents will enable

[a] Published in Eighteenth Annual Report of this Bureau (pp. 41–182); also as Bulletin No. 42, Bureau of Animal Industry.

the prompt recognition of this disease should it appear in the United States.

HOOKWORM DISEASE IN MAN.

Persons, such as miners, excavators, farmers, etc., whose daily work brings them in contact with moist dirt, are subject, in Europe, Asia, Africa, South America, and Central America, to a disease known under the various names of uncinariasis, anchylostomiasis, brickmaker's disease, etc. A few cases of this malady have been reported for the United States, but it has been assumed that such cases were imported directly or indirectly from Europe. During this last year, however, we have been able to prove that this malady, as it occurs in the United States, is due to two distinct parasites. One of these is the Old World hookworm (*Uncinaria duodenalis*), so common in Italy and Africa, and the other is an endemic New World form, which Dr. Stiles, zoologist of the Bureau, has named *Uncinaria americana*. This disease is an important one from the agricultural standpoint because of its frequency in farm hands in certain countries, and the indications are that it is much more common in this country than has heretofore been supposed.

At the request of Dr. Walter Wyman, Surgeon-General of the United States Public Health and Marine-Hospital Service, the Zoological Laboratory has prepared an article upon this disease, giving an account of the structure and life history of the parasite, together with a discussion of symptoms, treatment, prevention, etc.[a]

MISCELLANEOUS WORK.

The Zoological Laboratory has been called upon for the determination of a number of parasites of various kinds which have been sent in by farmers, veterinarians, physicians, boards of health, etc., and has issued several publications describing some of the forms in question. The zoologist was also detailed to the United States Army Medical School, at the request of Surgeon-General Sternberg, to give a course of instruction in medical zoology to the newly appointed medical officers.

DETAILS TO SCIENTIFIC MEETINGS.

The zoologist was also detailed to represent the Department of Agriculture at the International Zoological Congress held in Berlin, Germany, in 1901, and has continued to serve on the international commission on zoological nomenclature.

THE BUREAU EXPERIMENT STATION.

During the year ended June 30, 1902, the station was compelled to give so much time to the work required of it by the several labora-

[a]Published in Eighteenth Annual Report of this Bureau (pp. 183–219).

tories of the Bureau that practically no independent investigations of importance could be undertaken. This is true not only with respect to time, but also with regard to the space and facilities for properly handling experiments concerning a variety of infectious diseases.

In addition to testing a number of supposedly pathogenic germs on cattle, donkeys, hogs, sheep, and smaller experiment animals, investigations concerning the following diseases were conducted during the year: Hog cholera, swine plague, tuberculosis, tetanus, rabies, anthrax, Texas fever, foot rot of sheep, an infectious disease of horses resembling and probably identical with maladie du coït, and a number of affections of minor importance. Other work conducted by the Experiment Station was the growing of several varieties of cattle ticks, experiments with drugs for the removal of internal parasites from domestic animals; the production of antitoxic sera for the treatment of swine plague, hog cholera, tuberculosis, and tetanus; the care and protection from exposure to disease of animals for producing normal sera, and the breeding and rearing of numerous small experiment animals for the use of the Bureau laboratories.

MISCELLANEOUS DIVISION.

QUARANTINES.

The work of the quarantine stations during the past fiscal year shows a marked increase over that of the preceding year, more than double the number of cattle having passed through the various quarantine stations.

Quarantine station for the port of Baltimore.—Necessary repairs were made on the buildings, fences, water-supply apparatus, and loading and unloading chutes for this station, located at Halethorp, Md., where 227 head of Hereford cattle were comfortably quarantined.

Quarantine station for the port of New York.—The property at Garfield, N. J., which has been leased by the Government and maintained as a quarantine station for the port of New York since 1883, was vacated September 30, 1901. The transfer to the new station, having been in progress during the summer, was completed at this time. The active work of establishing the new quarantine station for the port of New York was begun April 1, 1901. Successful negotiations for a very desirable tract of land at Athenia, N. J., in the foothills of the Orange Mountains, 12 miles in a direct line from New York, were conducted by the Bureau of Animal Industry, and the ground was purchased in six parcels from as many separate owners, at a price that was considered very reasonable for land so favorably located in that section.

Immediately after the preliminaries of plotting the ground, laying out the streets, and locating the buildings, the erection of six stables was begun and rapidly pushed to completion. These are of a substantial character and attractive design, constructed of brick, with

bluestone trimmings, with front and rear entrances sufficiently wide to admit of the passage through them of a horse and cart, and have been built with a view to securing every possible advantage in the way of sanitation and hygiene. Four of them accommodate 11 cattle each and two 17 each. In addition, during the first half of the fiscal year substantial stone foundations, with cement floors for three larger buildings, were erected and temporary stables moved from the old station were placed on them, one having a capacity of 80 head of cattle, the other two 22 each. To these accommodations there were also added six frame stables, which were likewise removed from the old station, giving an additional capacity of 208 cattle.

At the close of the fiscal year it is found that cattle, sheep, and hogs in quarantine here, together with those for which permits have been issued, will occupy all of the available space; and it is the purpose of the Department to erect permanent structures of brick and stone of the same design as the first six stables, and of varying capacities, in order to accommodate both large and small importations, until this station shall afford ample room and proper facilites for quarantining all animals of the class requiring quarantine that shippers may desire to enter at the port of New York, and until permanent brick and stone stables shall have supplanted the old frame barns brought over from Garfield and put up to meet the immediate needs of the station.

The above 15 buildings have an aggregate capacity of 410 cattle when the box stalls are used for large bulls or single animals. They might, under certain conditions, as when two or more small cattle could be placed in a box stall, accommodate 425 cattle.

The Department has expended thus far for land, buildings, and improvements, including an adequate water system for all purposes, about $61,000; and the appropriation by Congress, available July 1, will admit of the further erection of buildings and the continuance of improvements.

Quarantine station for the port of Boston.—This station is favorably located in a beautiful section of country at Littleton, Mass., and has received such attention, repairs, and improvements as were required to make it a desirable quarantine station, and, like the station at Baltimore, offers to importers advantages that are liable to be overlooked simply through the fact of a lesser prominence and popularity as a port of entry when compared with New York.

Animals quarantined.—The animals enumerated have all been subjected to inspection and quarantine, the length of the quarantine period being fixed in accordance with the requirements for the subdivision of the class to which they belong. The imports of animals from Canada not subject to quarantine at quarantine stations comprised 27,716 cattle, 148,313 sheep, 3,305 horses, 5,356 hogs, 2 dogs, 5 goats, 1 mule, and 2 moose—total, 184,700.

The following table shows the number and kinds of animals detained in quarantine for the requisite time:

Station.	Cattle.	Sheep.	Hogs.
Littleton, Mass	60	42	-------
Garfield, N. J	62	8	5
Athenia, N. J	588	118	7
Halethorp, Md	227	---------	-------
Port Huron, Mich	22	---------	-------
Detroit, Mich	2	2	1
Sault Ste. Marie, Mich	2	---------	-------
Ogdensburg, N. Y	1	---------	-------
Hogansburg, N. Y	6	---------	-------
Alexandria Bay, N. Y	4	---------	-------
Cape Vincent, N. Y	2	---------	-------
Buffalo, N. Y	49	---------	-------
Charlotte, N. Y	2	---------	-------
Richford, Vt	8	2	5
Newport, Vt	19	8	-------
Island Pond, Vt	1	5	3
Beecher Falls, Vt	101	1	-------
Houlton, Me	45	39	4
Vanceboro, Me	4	---------	-------
Calais, Me	4	6	1
San Francisco, Cal	5	---------	7
Total	1,214	231	33

There was also imported through the port of New York and quarantined, under the supervision of the superintendent of the Athenia, N. J., quarantine station, the following: Forty-six deer, 5 aoudads, 1 yak, 2 elephants from India, 2 wart hogs, 43 camels, 9 antelopes, 6 goats, 1 horned horse, 4 llamas, 2 alpacas, 1 wild boar, 1 chamois, 2 guanacos, 1 anoa, 7 caribou—total, 133 animals; through the port of Boston, Mass., and quarantined under the supervision of the superintendent of the quarantine station at Littleton, Mass., 6 deer, 1 camel, and 1 llama—total, 8 animals; at Philadelphia, Pa., and quarantined under the supervision of the inspector in charge for that port, where a special temporary quarantine was established for the purpose, 9 deer, 2 wart hogs, 6 camels, 1 horned horse, 1 water buffalo, and 1 thar—total, 20 animals; Detroit, Mich., 1 goat; San Francisco, Cal., 7 llamas. This makes a total of 1,649 imported animals that were quarantined.

The official veterinarian stationed at London, England, in accordance with the requirements of Bureau of Animal Industry Order No. 79, under date of November 10, 1900, which provides for the testing with tuberculin by an inspector of this Bureau of all cattle over 6 months old which are to be imported into the United States, has tested of the different breeds of purebred cattle in various parts of

Great Britain, 1,067 cattle, of which 139 reacted and 928 passed, as follows:

Breed.	Passed.	Rejected.	Breed.	Passed.	Rejected.
Shorthorn	84	27	Hereford	294	15
Jersey	191	1	Galloway	1	
Aberdeen Angus	186	73	Dexter Kerry	15	
Ayrshire	25	8	Total	928	139
Guernsey	79	11			
Red poll	53	4			

In Canada the veterinarians of this Department tested with tuberculin 382 cattle, of which 355 passed and 27 reacted, as follows:

Breed.	Passed.	Rejected.	Breed.	Passed.	Rejected.
Aberdeen Angus	3		Ayrshire	17	6
Jersey	24		Durham	4	
Hereford	26	1	Grades	84	
Shorthorn	188	20	Total	355	27
Holstein	9				

A VENEREAL DISEASE OF HORSES.

The work which the Bureau has been carrying on for the purpose of eradicating an infectious venereal disease of horses, which work has been continued throughout the year, has not given those results that it was hoped would be secured. The semiwild condition of much of the country over which the disease had spread, as comprised in the Rosebud and Pine Ridge Indian reservations, South Dakota, and other parts of South Dakota, Nebraska, and Wyoming, together with the prejudices and the lack of cooperation and aid that should have been given by the owners and others whose interests were to be served, proved serious hindrances.

Another obstacle consists in the methods of certain horse traders, who commence at the northwestern corner of the State of Nebraska with a mixed lot of horses, many of which are very inferior, and trade all the way across the State to the Missouri River, frequently giving two horses for one, thus leaving behind such animals as might have shown indications of disease or of being unsound, so that they would reach the Missouri River with a greatly improved band of horses, and possibly scatter a number that were diseased along the route, as they aim to get rid of all suspicious animals before reaching the eastern border of the State.

Three diseased mares and one stallion have been shipped in from the Pine Ridge Indian Reservation to the Experiment Station of the Bureau, located at Bethesda, Md., for the purpose of giving oppor-

tunity for a closer clinical study of the disease and for procuring fresh material for laboratory investigation. The work in this connection has been of an encouraging character, but, owing to the fact that the stallion's condition rendered him valueless except for postmortem work, this specimen of the disease was unsatisfactory. However, valuable progress has been made and work in these lines is being continued, and it is hoped that both the investigation as to the causative agent and its life history, as well as the attempt of the Bureau to stamp out the disease, will, as a result of broader and more aggressive operations, which are in contemplation for the early fall, soon meet with success.

During the year 10 diseased stallions were purchased and slaughtered at an average cost of $25 each, or $250; 29 diseased stallions were castrated, and 76 diseased mares were purchased and slaughtered at an average cost of about $18.35, or $1,395, making a total of $1,645. Seven diseased mares were slaughtered, owners unknown, for which nothing was paid. At the close of the fiscal year, 15 diseased mares are held in quarantine to be disposed of.

MISCELLANEOUS WORK.

In addition to the work in connection with the animal quarantines as above, this division has a general supervision of the accounts and other work of the Bureau of Animal Industry as follows: Salaries, reimbursement of expenses incurred by its officers and employees in travel and at various stations; apparatus and supplies for the various divisions, their laboratories, the experiment station, and quarantine stations; all accounts of every character that are paid from the appropriation for the Bureau of Animal Industry; the preparation of an itemized report to each Congress, showing in detail the character of expenditures and the use of the appropriation; the making out of all appointments, transfers, promotions, furloughs, reinstatements, resignations, and dismissals; the making of requisitions and securing of informal bids for all materials and supplies used throughout the work of the Bureau, and the necessary letter writing incident thereto. The division also has charge of the preparation of replies to numerous letters requesting information in regard to the diseases of animals and poultry, their causes and treatment, and various other matters pertaining to breeds, breeding, and care of domesticated animals and allied subjects. This is the character of the routine work performed each year.

DAIRY DIVISION.

The work of the Dairy Division during the fiscal year ended June 30, 1902, resembled that of previous years so closely that it can be largely reported in the language formerly used.

A general survey of the condition of the dairy industry of the

country at large was begun upon the organization of the division. This has been continued, and special inquiries have been made, such as the status of dairy organizations, dairy schools and facilities for technical instruction, State dairy laws, the development of foreign markets for the dairy products of this country, the milk supply of cities and towns, and laws and ordinances relating thereto. Some reports have been printed and others are in course of preparation.

As heretofore, attention is given to the collection of dairy data in general, with a view to their proper arrangement and future use. So far as the clerical force of the office permits, the material collected has been indexed for ready reference. Although necessarily much in arrears, this catalogue of dairy information is of great value and in constant use.

The routine work of the office continues to increase and has become so great as to be managed with some difficulty, even with the increased clerical force provided. This routine embraces general correspondence, with many requests for specific information from all parts of the country, preparing instructions for the dairy inspectors in the field and attention to their reports, and the preparation of reports and other manuscripts for publication. During this year the division has prepared four distinct publications for distribution and nearly completed two others, the publication of which is necessarily somewhat delayed. These, collectively, comprise about 200 printed pages, nearly three-fourths of which first appeared in the Annual Report of the Bureau, and were separately reprinted. All have been liberally illustrated from original photographs obtained for the division or made by its officers.

Dairy centers in fifteen different States have been visited during the year by the chief or assistant chief of the division, and conventions of dairy associations and similar bodies have been attended in ten States. A special agent of the Bureau, on duty for this division, visited Japan, China, and the Philippines for the purpose of investigating market conditions and arranging for a series of experimental exports of dairy products from this country. Another special agent examined the conditions along the Canadian border with reference to dairy products crossing the line in the course of exports. A third special agent made an investigation into the manufacture of certain kinds of cheese in Belgium and Holland.

Experimental exports of dairy products have been made to Japan, China, Cuba, and Porto Rico. This method of making known the better grades of these products has resulted in somewhat increased sales by merchants in San Francisco and New York, and some parties elsewhere, but inadequate or unsuitable transportation facilities, the destructive climates of some of the countries referred to, and other unfavorable conditions prevent any rapid increase in this trade. Japanese markets may well be further cultivated from the Pacific

coast, but in China, aside from condensed milk, the fresh supplies from Australia possess advantages with which shipments from this country can not successfully compete. Inquiry by correspondence indicates that there are good opportunities for finding markets for dairy products from the United States in Mexico and South America, if proper exertions are made in that direction.

Commencing with this fiscal year, and in accordance with an act of Congress approved March 2, 1901, a system was inaugurated for inspecting dairy products offered for export, affixing stamps to the same, and certifying to the character and quality of the articles. The law states the object to be "ascertaining the purity and quality of such products" and "to secure their identity and make known in the markets of foreign countries to which they may be sent from the United States their purity, quality, and grade." Although the authority granted may cover all dairy exports, it has been deemed expedient, at least for the present, to confine the certification to products which special inspection shows to be "pure, of high quality, and suitable for export." Special agents were accordingly appointed and placed on duty as "inspectors of dairy exports" at the ports of Boston, New York, and San Francisco, and also at Chicago. This service has been occasional only, or more or less continuous, according to the needs of the respective localities. During the last year the relations of foreign markets to those of the United States have been rather abnormal, prices being such in this country as to prevent any considerable export of high-grade goods other than condensed milk and cream. While the service of these inspectors has therefore resulted in obtaining full information as to the character of our dairy export trade and the circumstances attending it, there have been few inspections requested by exporters and still fewer certificates given.

At the request of the Secretary of the Navy, this Department has assisted in perfecting specifications and arranging for the execution of contracts for securing an improved supply of butter for the Navy. Inspectors representing this division have been stationed at the places of manufacture, and have seen that only butter of extra quality has been packed and delivered under these contracts. The result has been that the butter in naval stores has been of a higher average quality than ever before, while the cost of the same has been relatively low—a decided saving over the system of previous years.

Incident to the experimental exports and the inspection service noted, a large number of chemical analyses of milk, condensed milk, and cream, butter, and cheese have been necessary. This work has been accomplished by the dairy laboratory of the Biochemic Division of this Bureau, where a chemist and laboratory assistant have been kept constantly employed. In this connection special studies have been made of the products of nearly all dairy countries of the world, as found in many foreign markets. Experimental studies have also

been made of the essential differences between (natural) butter, renovated butter, and butterine, or oleomargarine, and the most practical methods of distinguishing or identifying these different articles.

At the Pan-American Exposition at Buffalo the Dairy Division contributed a portion of the exhibit of this Bureau and provided for its arrangement. Later, the same exhibited was made at the Charleston Exposition.

The act of Congress approved May 9, 1902, by its section 5 (and incidentally under section 4), places certain specific and important duties upon the Secretary of Agriculture, relating to the manufacture, interstate commerce, and export of "renovated butter," and the details of administration have been assigned to the Dairy Division. The work resulting from this action will be noted later.

Disconnected officially with this office, and yet closely related to it, has been certain work performed during the year in connection with the Twelfth United States Census. The chief of this division received from the Director of the Census, early in the year 1900, an appointment as expert special agent (without compensation) in charge of the statistics of butter, cheese, and condensed-milk factories. Advisory and supervisory duties were performed accordingly, from time to time, ending with the preparation of a report upon the establishments of the class indicated, and the data obtained from them, in the division of manufactures, which was published in June, as Census Bulletin No. 189. This office was also frequently consulted by the agricultural division of the Census, as to editing the dairy data collected from farms.

The work of the Dairy Division during the fiscal year 1902–3 will embrace, in large measure, a continuation of that of previous years and also include several material additions.

The condition of the dairy industry in the United States will be studied in all its aspects, with a view to determining the most favorable opportunities for progress and improvements and assisting in their accomplishment so far as practicable. The dairying of other countries must also be observed, productive conditions noted, the demands of consumption and of all foreign markets watched, and such action taken as is possible in the interest of extending foreign trade in dairy products. Relations will be maintained with State dairy officials, with the voluntary organizations of dairymen, and with the dairy schools in numerous States, in order to be informed of their proceedings and cooperate with them so far as may be advisable. The investigations of the agricultural experiment stations along dairy lines will be closely watched and facts collected which may be usefully disseminated.

This division will conduct investigations by itself or in cooperation with suitable agencies. It is proposed in particular to study the methods of preparation, chemical composition, and keeping quality

of creamery butter, and special methods of preparing and packing butter for export to warm climates; also to test the recommended methods of curing cheese at low temperature.

The very important subject of municipal milk supply needs further attention, and the preparation of a special report upon it is intended.

Other reports are also in preparation and proposed. Among them will be a compilation of dairy statistics of this and other countries, and the latest available.

The inspection of dairy products exported from this country, which has been largely experimental during the past year, is expected to assume a systematic condition during the present one. Much depends, however, upon the dairy markets at home and abroad and the commercial conditions which influence the export trade.

Inspection of the manufacture and interstate commerce of renovated butter will be begun at once under act approved May 9, 1902, going into effect July 1, 1902. In this connection it is proposed to make special exertions to have all renovated butter hereafter exported from this country so thoroughly stamped, marked, and labeled as to insure its commercial identity and make known its true name and character to buyers and consumers, so long as the merchandise is within the jurisdiction of the United States; also to inform the principal importers of foreign countries, and of Great Britain in particular, in regard to the law and the action thereunder by this Department.

THE WORK AGAINST SHEEP SCAB IN 1902.

By E. B. Jones, LL. M., M. D.,

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The review of the work for the suppression of sheep scab during 1901, published in the report of the Bureau for that year, showed an improvement over the results obtained in 1900, and it is gratifying to be able to state that the good work of 1901 has been excelled during 1902.

The compilation of the reports received shows the inspection of 15,327,766 sheep, as against 10,103,806 last year, an increase of 5,223,960, or 51.7 per cent. The number of sheep dipped was 1,840,308, as against 886,645 last year, an increase of 953,663, or 107.6 per cent; and, in addition, 275,921 of them were given a second dipping. The number of scabby sheep received at stock yards where regular stations of the Bureau are maintained fell from 166,800 to 113,507, a decrease of 53,293, or 32 per cent. The excellent record of last year with regard to the effectiveness of the dipping done by direction of the Bureau's inspectors is very little more than equaled this year, the percentage of effective work rising from 91.8 to 92.

The previous reports have directed attention to the generally successful result of the single dipping, but it seems that this statement should be modified to a slight extent, because, although it is true that in a great majority of cases a single dipping was given, in some instances the sheep were dipped a second time by the Bureau's inspectors, and also in many instances the owners dipped them a second time, after they reached the farm or ranch. The number of second dippings, however, was greatly increased during this year in the Western States.

In the table herewith will be found the figures showing the work done in the different States and Territories. It should be observed that the total should not be taken to mean that so many different sheep were inspected, for the reason that many of them were reported from two or perhaps three or more stations, where they passed under the notice of the inspectors; this is especially true with regard to the sheep inspected in Nebraska, Missouri, and Illinois.

From the accompanying table it is seen that in an aggregate of 15,327,766 sheep inspected, flocks comprising 1,366,007 head were reported as infected; this gives a percentage of infection of 8.9, as against 7.5 in 1901. Taking the figures for the principal sheep-raising States, and comparing them with those for 1901, we find that in a majority of these States the degree of infection is diminished, notably more in Oregon, North Dakota, Idaho, Arizona, and Missouri (principally in receipts at Kansas City stock yards), and to a less extent in California, New Mexico, Nebraska, and Minnesota. Nevada, Colorado, and Illinois remain practically unchanged in the proportion of infected sheep

to number inspected. There appears a slight increase of infection in the flocks inspected in Washington, Texas, and Kansas, but the percentage in the former two States is very small. Viewing the figures for Utah and Wyoming we find the reason for the increased percentage of infection this year. In these two States the work was extended during the year and nearly twice as many sheep inspected as in 1901, with the result of raising the percentage of infection found in Wyoming from 5.8 to 10 and in Utah from 14.9 to 53.7. It was in Utah that the greater number of sheep were dipped twice. It should be noted that Montana, with nearly a million sheep inspected, equals the enviable record established for that State last year, when no infection was reported; similar mention may also be made of Oklahoma and the Indian Territory, although for a very much less number of sheep.

Summary of inspection and dipping of sheep for scabies during the year 1902.

State.	Number inspected.			Number dipped.				Number given second dipping.
	Free.	Infected.	Total.	Infected.	Exposed.	Precautionary.	Total.	
Arizona	110,055	5,900	115,955	1,450			1,450	
Arkansas	11,722		11,722					
California	285,580	27,102	312,682	23,602	600		24,202	22,152
Colorado	897,183	87,313	984,496	60,235	342		60,577	2,836
Idaho	882,693	6,412	889,105	3,012			3,012	
Illinois	2,586,003	190,915	2,776,918	46,565	4,105	300,532	351,202	
Indiana	801	342	1,143					
Iowa	15,232	1,599	16,831	1,193		405	1,598	
Kansas	71,438	22,174	93,612	3,577			3,577	
Minnesota	537,037	6,888	543,925	4,325	510	1,798	6,633	
Missouri	431,287	21,954	453,241	7,220	28,242	197,553	233,015	138
Montana	966,305		966,305					
Nebraska	3,091,961	86,025	3,177,986	46,165	6,790	348,669	401,624	12,851
Nevada	448,285	138,118	586,403	105,123	5,151	50	110,324	47,843
New Mexico	646,986	102,831	749,817	27,568			27,568	13,500
New York	9,967	1,170	11,137	539		9,967	10,506	
North Dakota	128,525	1,275	129,800					
Ohio	16,811	2,624	19,435	1,414	1,689	15,122	18,225	
Oklahoma and Indian Territory	18,573		18,573					
Oregon	574,046	5,297	579,343	3,100	1,200		4,300	
South Dakota	27,651		27,651					
Texas	198,425	4,696	203,121	1,240			1,240	
Utah	425,405	494,120	919,525	430,556	12,656	3,260	446,472	149,840
Washington	201,494	3,259	204,753					
Wisconsin	2,200	2,400	4,600					
Wyoming	1,376,094	153,593	1,529,687	113,963	15,500	5,320	134,783	26,761
Total	13,961,759	1,366,007	15,327,766	880,847	76,785	882,676	1,840,308	275,921

With regard to South Dakota, while no infection was found among the comparatively few sheep inspected in that State, as shown in the table, it must not be inferred that that State is free from scab. Quite the contrary is the case, because many shipments of scabby sheep from there have been received at various stock yards in other States.

In the Bureau report for 1901 a statement was made with reference to the comparative receipts of scabby sheep in 1901 and 1900, and the apparently great decrease was used as the basis of a flattering conclusion respecting the efficacy of the system of inspection in preventing the extensive shipment of diseased sheep. Unfortunately, the figures for the dipping of infected sheep at the different stations in 1901 were inadvertently used instead of the figures giving the receipts, and the deduction was, therefore, to some extent erroneous. The following table shows the number of scabby sheep received at various stock yards during each month of the year, and also gives the totals for three years in order to show the progressive diminution in the number since the Bureau has been actively at work against this disease:

Statement showing the number of scabby sheep received at regular stations during each month of the year 1902 and the totals for the years 1902, 1901, and 1900.

Station.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
Buffalo	29	318	655	22	108		
Chicago	4,971	1,671	8,600	7,540	437		146
Cincinnati	41				198	141	564
Indianapolis	85			16	15		
Kansas City	964	2,023	319			1,583	421
National Stock Yards	65	100			31	46	
Pittsburg							
Portland, Oreg				200			415
Seattle							
Sioux City	41	190		20			
South Omaha	2,640	5,654	7,503	2,691	1,617	176	929
South St. Joseph	521	460	603		37	538	
South St. Paul	1,600	693					109
Total	10,957	11,109	17,680	10,489	2,443	2,484	2,584

Station.	Aug.	Sept.	Oct.	Nov.	Dec.	Totals. 1902.	1901.	1900.
Buffalo				38		1,170	1,647	1,846
Chicago	448	855	3,120	3,745	12,637	44,170	74,708	38,573
Cincinnati	1,005	100	139		436	2,624	5,518	2,189
Indianapolis				116	110	342	600	174
Kansas City	140	1,073	3,858	2,776	3,873	17,030	38,109	49,089
National Stock Yards		336		383	256	1,217	1,114	16,638
Pittsburg							571	
Portland, Oreg				250	232	1,097	2,662	1,151
Seattle			710	1,934	365	3,009	447	
Sioux City				1,260	88	1,599	2,034	286
South Omaha	816	404	7,079	648	2,628	32,785	28,896	52,026
South St. Joseph		190	715	199	1,061	4,324	5,806	12,125
South St. Paul	225	17	111	1,168	217	4,140	4,688	472
Total	2,634	2,975	15,732	12,517	21,903	113,507	166,800	174,569

Nearly all the infected sheep received at these places, and also the ones exposed to the contagion through contact with them, were held

for slaughter; some were, however, allowed to go out after dipping. The dipping at these places is almost entirely a precautionary measure, as it would be assuming a risk to allow sheep that had been possibly exposed to the disease in the stock yards to be taken out into the country for stocking or feeding purposes without first giving them this treatment. The table below shows the dipping at some of the principal stock yards and the kinds of dip employed:

Statement showing the number of sheep dipped and kind of dip used at regular stations January 1 to December 31, 1902.

Where dipped.	Kind of dip used.	Infected.	Exposed.	Precautionary.	Total.
Buffalo	Lime and sulphur	539		9,967	10,506
Chicago	Nicotine and sulphur	25		83,351	83,376
	Tobacco extract and sulphur			216,412	216,412
Total		25		299,763	299,788
Cincinnati	Tobacco extract and sulphur	1,414	1,689	15,122	18,225
Kansas City	Nicotine and sulphur			9,586	9,586
	Tobacco extract and sulphur		177	4,989	5,166
	Lime and sulphur	6,579	27,146	163,326	197,051
Total		6,579	27,323	177,901	211,803
National Stock Yards	Nicotine and sulphur			769	769
South Omaha	Tobacco extract and sulphur	13,687	3,490	348,669	365,846
Sioux City	Nicotine and sulphur	1,193		405	1,598
South St. Joseph	Nicotine and sulphur	779		4,640	5,419
	Lime and sulphur		919	15,012	15,931
Total		779	919	19,652	21,350
South St. Paul	Nicotine and sulphur			512	512
	Tobacco extract and sulphur	1,875	423	1,286	3,584
Total		1,875	423	1,798	4,096
Total by dips	Nicotine and sulphur	1,997		99,263	101,260
	Tobacco extract and sulphur	16,976	5,779	586,478	609,233
	Lime and sulphur	7,118	28,065	188,305	223,488
Grand total		26,091	33,844	874,046	933,981

At the end of the year the Bureau sent out to owners of sheep a circular making inquiry with regard to the effectiveness of the dipping their sheep had received. A larger number of replies were returned than in previous years and they were used in the compilation of the table below. Naturally, in a case of this kind, the returns may not be accepted as absolutely accurate; the responses, though evidently made in good faith, being in many instances doubtless influenced one way or another by lack of knowledge of the disease, by a mistaken opinion or belief, or by failure to recall circumstances and dates after a considerable time had elapsed.

Statement showing the efficacy of dips used on sheep exposed to and infected with scab, January 1 to December 31, 1902, compiled from 957 replies to circular letter of December 31, 1902, sent to owners.

Where dipped.	Nicotine and sulphur.				Tobacco extract and sulphur.				Lime and sulphur.				Totals.				
	Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		Grand total.
	Number.	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Buffalo									6,988	100			6,988	100.			6,988
Chicago	35,581	81.7	7,995	18.3	90,782	83.9	17,452	16.1					126,363	83.2	25,447	16.8	151,810
Cincinnati					5,230	81.8	1,162	18.2					5,230	81.8	1,162	18.2	6,392
Kansas City									*a 365*	*100*			*365*	*100.*			
	3,364	100			4,368	100			142,563	99	1,511	1	150,295	99	1,511	1	
Total	3,364	100			4,368	100			142,928	99	1,511	1	150,660	99	1,511	1	152,171
National Stock Yards	1,150	100											1,150	100			1,150
Sioux City	*92*	*100*											*92*	*100*			
	130	100											130	100			
Total	222	100											222	100			222
South Omaha					*2,542*	*100*							*2,542*	*100*			
					224,426	99.2	1,805	0.8					224,426	99.2	1,805	0.8	
Total					226,968	99.2	1,805	0.8					226,968	99.2	1,805	0.8	228,773
South St. Joseph	*503*	*100*											*503*	*100*			
	4,306	100							12,496	100			16,802	100			
Total	4,809	100							12,496	100			17,305	100			17,305
South St. Paul	512	100			2,624	91.5	244	8.5					3,136	92.8	244	7.2	3,380
Wichita									*599*	*100*			*599*	*100*			599

a Infected sheep are shown in italic figures.

Statement showing the efficacy of dips used on sheep exposed to and infected with scab, etc.—Continued.

Where dipped.	Nicotine and sulphur.				Tobacco extract and sulphur.				Lime and sulphur.				Totals.				
	Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		Grand total.
	Number.	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
California									[a] *3,350*	*33.1*	*6,768*	*66.9*	*3,350*	*33.1*	*6,768*	*66.9*	10,118
Colorado					*4,380*	*100*			*5,075*	*100*			*9,455*	*100*			9,455
Idaho									*410*	*100*			*410*	*100*			410
Nebraska (outside So. Omaha)					*2,410*	*100*			*26*	*100*			*2,436*	*100*			2,436
Nevada			*2,200*	*100*					*6,250*	*56.5*	*4,815*	*43.5*	*6,250*	*47.1*	*7,015*	*52.9*	13,265
New Mexico									*217*	*100*			*217*	*100*			217
Utah									*140,591*	*87.9*	*19,300*	*12.1*	*140,591*	*87.9*	*19,300*	*12.1*	159,891
Wyoming									*18,217*	*100*			*18,217*	*100*			
					5,510	100			2,460	100			7,970	100			
Total					5,510	100			20,677	100			26,187	100			26,187
Total infected	*595*	*21.3*	*2,200*	*78.7*	*9,332*	*100*			*175,100*	*85*	*30,883*	*15*	*185,027*	*84.8*	*33,083*	*15.2*	*218,110*
Total exposed	45,043	84.9	7,995	15.1	332,940	94.2	20,663	5.8	164,507	99.1	1,511	0.9	542,490	94.7	30,169	5.3	572,659
Grand total	45,638	81.7	10,195	18.3	342,272	94.3	20,663	5.7	339,607	91.3	32,394	8.7	727,517	92	63,252	8	790,769

[a] Infected sheep are shown in italic figures.

This statement shows that the dipping under the supervision of the Bureau officials (in most cases a single treatment) was effective in curing or preventing scab in 92 per cent of all cases; that it was effective in 84.8 per cent in curing infected sheep, and effective in 94.7 per cent among exposed sheep. The figures would make a better showing if the dipping at Chicago this year had equaled the results of the preceding years. The replies cover flocks of sheep containing 790,769 head, the corresponding statement last year showing only 356,359 head.

Reviewing these statistics, it appears that all the places have this year an excellent record, with the exception of Chicago, Cincinnati, California, Nevada, and Utah. With regard to Chicago, it is difficult to account for the poor results of the dipping there; two different preparations were used—one for about eight or nine months and the other for the rest of the time, and one appears to have but little advantage over the other. Some of the replies to the inquiry suggest the possibility of infection in the cars after dipping; others think that the dip was not strong enough or was not changed often enough. The bad showing of Cincinnati is more apparent than real; one lot of sheep, comprising three-fourths of the number entered in the table as ineffective, showed signs of the disease in four individuals about two months after they were first dipped; the owner gave them a second dipping twenty days after the first, and he attributes their condition to exposure in a pasture in which some scabby sheep had been two months before.

In California and Nevada, where the results are exceptionally poor, it is evident from the replies that the sheep acquired the disease after dipping, either by contact with scabby sheep or by grazing on infected ranges. In some cases the sheep were dipped a number of times during the season, as they were grazed in both of these States and had to be dipped before crossing the State line. Frequent dipping gave the sheep a setback, but no especial effort to get rid of the disease by other means seems to have been made. In Utah the sheep graze on the public range and are liable to become infected by this exposure to contagion.

A comparison of the three kinds of dip used in 1902, as obtained from the replies from owners, shows their order of effectiveness in the treatment of infected sheep to have been as follows: Tobacco extract and sulphur, 100 per cent; lime and sulphur, 85 per cent; nicotine and sulphur, 21.3 per cent.

With reference to the nicotine and sulphur, it should be stated that replies concerning only three infected flocks were received; in two of these the dipping was successful, and the low percentage of effectiveness is due to its apparent failure in the other flock, which contained about four-fifths of these sheep. This latter flock was, in fact, dipped

several times, as it crossed the line between Nevada and California many times and was exposed by being driven upon infected ranges. So while the results recorded make it appear that nicotine and sulphur failed with 78.7 per cent of the sheep treated with it, it is quite safe to presume that the sheep became infected on the range after dipping each time.

In the treatment of exposed sheep lime and sulphur stands first, with 99.1 per cent; tobacco extract and sulphur next, with 94.2 per cent; nicotine and sulphur last, with 84.9 per cent. In general effectiveness the order is: Tobacco extract and sulphur, 94.3 per cent; lime and sulphur, 91.3 per cent; nicotine and sulphur, 81.7 per cent. It should be noted in favor of the lime-and-sulphur combination that it was used in dipping much the greater part of the infected flocks (205,983 sheep out of a total of 218,110 reported infected), and that while two dippings were given in many cases the fact remains that they were more exposed to subsequent infection.

The following table is presented for comparison of the results achieved with different preparations during 1900, 1901, and 1902:

Statement showing efficacy of dips used on sheep exposed to and infected with scab for the years ended December 31, 1900, 1901, and 1902.

Where dipped.		Nicotine and sulphur.				Extract of tobacco and sulphur.				Lime and sulphur.				Totals.				Grand total.
		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		
		Number.	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Buffalo	1900									6,027	90	639	10	6,027	90	639	10	6,666
	1901					2,401	100			11,201	98	220	2	13,602	98.4	220	1.6	13,822
	1902									6,988	100			6,988	100			6,988
Chicago	1900	170,952	92	14,075	8									170,952	92	14,075	8	185,027
	1901	116,744	92	10,141	8									116,744	92	10,141	8	126,885
	1902	35,581	81.7	7,995	18.3	90,782	83.9	17,452	16.1					126,363	83.2	25,447	16.8	151,810
Cincinnati	1900					8,613	100							8,613	100			8,613
	1901					3,496	97.7	84	2.3					3,496	97.7	84	2.3	3,580
	1902					5,230	81.8	1,162	18.2					5,230	81.8	1,162	18.2	6,392
Kansas City	1900	7,036	64	4,020	36	23,037	72	8,783	28	31,372	67	15,421	33	61,445	69	28,224	31	89,669
	1901	1,121	100			1,407	100			24,441	92.1	2,080	7.9	26,969	92.8	2,080	7.2	29,049
	1902	3,364	100			4,368	100			142,928	99	1,511	1	150,660	99	1,511	1	152,171
Louisville	1900					1,737	100							1,737	100			1,737
	1901					282	69	130	31					282	69	130	31	412
	1902					0		0						0		0		0
National Stock Yards	1900	6,036	74	2,080	26									6,036	74	2,080	26	8,116
	1901	10,164	92	880	8									10,164	92	880	8	11,044
	1902	1,150	100											1,150	100			1,150
Sioux City	1900					11,365	100							11,365	100			11,365
	1901					85	100							85	100			85
	1902	222	100											222	100			222
South Omaha	1900					136,214	93	9,704	7	15,332	83	3,105	17	151,546	92	12,809	8	164,355
	1901					85,581	86	13,922	14					85,581	86	13,922	14	99,503
	1902					226,968	99.2	1,805	0.8					226,968	99.2	1,805	0.8	228,773
South St. Joseph	1900	6,183	64	3,480	36									6,183	64	3,480	36	9,663
	1901	787	51.2	750	48.8	467	73	170	27					1,254	57.7	920	42.3	2,174
	1902	4,809	100							12,496	100			17,305	100			17,305

Statement showing efficacy of dips used on sheep exposed to and infected with scab, etc.—Continued.

Where dipped.		Nicotine and sulphur.				Extract of tobacco and sulphur.				Lime and sulphur.				Totals.				Grand total.
		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		
		Number.	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
South St. Paul	1900	100	100			1,695	93	125	7					1,795	93	125	7	1,920
	1901					1,000	100							1,000	100			1,000
	1902	512	100			2,624	91.5	244	8.5					3,136	92.8	244	7.2	3,380
Arizona	1900											0						0
	1901											115	100			115	100	115
	1902											0						0
California	1900									0		0		0		0		0
	1901									0		0		0		0		0
	1902									3,350	33.1	6,768	66.9	3,350	33.1	6,768	66.9	10,118
Colorado	1900					0				0				0				0
	1901					0				0				0				0
	1902					4,380	100			5,075	100			9,455	100			9,455
Idaho	1900									0				0				0
	1901									0				0				0
	1902									410	100			410	100			410
Illinois (outside Chicago and National Stock Yards).	1900											0				0		0
	1901											900	100			900	100	900
	1902											0				0		0
Kansas (outside Kansas City).	1900									0				0				0
	1901									0				0				0
	1902									599	100			599	100			599
Nebraska (outside South Omaha).	1900					700	18.9	2,997	81.1	5,296	66.1	2,718	33.9	5,996	51.2	5,715	48.8	11,711
	1901									10,000	100			10,000	100			10,000
	1902					2,410	100			26	100			2,436	100			2,436
Nevada	1900			0						0		0		0				0
	1901			0						17,100	100			17,100	100			17,100
	1902			2,200	100					6,250	56.5	4,815	43.5	6,250	47.1	7,015	52.9	13,265

New Mexico	1900	......	......	......	......	......	......	......	......	10,570	100	......	......	10,570	100	......	......	10,570
	1901	......	......	......	......	......	......	......	......	8,690	100	......	......	8,690	100	......	......	8,690
	1902	......	......	......	......	......	......	......	......	217	100	......	......	217	100	......	......	217
Utah	1900	0	......	......	......	......	......	......	......	0	......	......	......	0	......	......	......	0
	1901	5,000	100	......	......	......	......	......	......	0		......	......	5,000	100	......	......	5,000
	1902	0	......	......	......	......	......	......	......	140,591	87.9	19,300	12.1	140,591	87.9	19,300	12.1	159,891
Wyoming	1900	0	......	......	......	......	......	......	......	2,400	42.1	3,300	57.9	2,400	42.1	3,300	57.9	5,700
	1901	12,000	100	......	......	......	......	......	......	15,000	100	......	......	27,000	100	......	......	27,000
	1902	0	......	......	......	5,510	100	......	......	20,677	100	......	......	26,187	100	......	......	26,187
Total	1900	190,307	88	23,655	12	183,361	89	21,609	11	70,997	74	25,183	26	444,665	86	70,447	14	515,112
	1901	145,816	92.5	11,771	7.5	94,719	87	14,306	13	86,432	96	3,315	4	326,967	91.8	29,392	8.2	356,359
	1902	45,638	81.7	10,195	18.3	342,272	94.3	20,663	5.7	339,607	91.3	32,394	8.7	727,517	92	63,252	8	790,769
Grand total		381,761	89.3	45,621	10.7	620,352	91.6	56,578	8.4	497,036	89.1	60,892	10.9	1,499,149	90.2	163,091	9.8	1,662,240

It appears that the effectiveness of the preparations used varies at different times and at different places. At Kansas City, which is the only place where all three dips were used, the returns show, in 1902, for nicotine and sulphur and for tobacco extract and sulphur, an effectiveness of 100 per cent, and for lime and sulphur 99 per cent; the latter preparation was used for 94.9 per cent of the number of sheep reported by the owners as dipped at Kansas City. Taking the results for the three years we find that, in general effectiveness, extract of tobacco and sulphur leads twice, and that lime and sulphur occupies first place once. The highest percentages are as follows: Ninety-six for lime and sulphur, in 1901; 94.3 for tobacco extract and sulphur, in 1902; 92.5 for nicotine and sulphur, in 1901. The average for the three years gives tobacco extract and sulphur 91.6 per cent, nicotine and sulphur 89.3 per cent, and lime and sulphur 89.1 per cent. It may be concluded from these statistics that the three kinds of dip reported upon are about equally meritorious, so far as their curative qualities are concerned, and that a good or bad result may be expected in proportion to the amount of care exercised in the preparation of and the application of the dip, and to the degree of caution observed to prevent subsequent infection through contaminated premises and pastures.

While the foregoing statistics demonstrate the value of a single dipping, too great reliance should not be placed upon it; as a prophylactic agent it may be employed with a large measure of confidence for sheep that have been but lightly exposed to contagion, but for sheep affected with the disease two dippings are requisite, and it is almost equally important to dip twice those that have been in contact with diseased animals. It may not be out of place to state again that many of the sheep reported upon above were dipped twice.

Some of the owners complained of the rough treatment sustained by their sheep at the hands of the men employed at the vats. These men are the employees of the persons operating the dipping plants and are not connected with the Department of Agriculture. It is, however, a source of regret that anything of the kind should have occurred, and it will be remedied wherever the Department's influence has sufficient weight, or where its authority can compel better methods. The instructions to the inspectors supervising the dipping operations are to secure as humane handling of the sheep as is consistent with efficient work, and, as the complaints are few compared with the number of dippings, it seems that they are generally successful in attaining this desirable object.

During the year 637 cars which had carried scabby sheep were cleaned and disinfected.

SCABIES IN CATTLE.[a]

By R. W. Hickman, Ph. G., V. M. D.,
Chief of Miscellaneous Division, Bureau of Animal Industry.

Numerous letters are addressed to the Department of Agriculture making inquiry with regard to a disease called Texas itch. As this disease does not exist except to a very limited extent, if at all, in Texas, it seems strange that this name should be applied to it. Dr. M. Francis, of the Texas Experiment Station, says that the disease has never been observed among the cattle of that State. It is also known as range itch, cattle itch, and cattle mange, the last being the correct name, as it really is mange, or scabies. This disease has prevailed to a considerable extent among the range cattle of the West and Northwest, and has been heard of in other portions of the country also, and inquiries are constantly received for instructions in its treatment.

CAUSE OF SCABIES, OR MANGE.

Scabies, or mange, of the ox is a contagious disease caused by a parasitic mite. Cattle are chiefly affected with but two varieties of these parasites, or mites, which belong to the class Arachnoidea. These are, first, the *Psoroptes;* second, the *Symbiotes.* The first is the one which most frequently affects them. It lives on the surface of the skin and gives rise to great irritation and itching by biting, and is most frequent upon the sides of the neck and shoulders, at the base of the horns, and at the root of the tail. From these points it spreads to the back and sides, and may invade nearly the entire body. Its principal manifestations are more or less numerous pimples, exudation, and abundant scaling off of the skin, falling out of the hair, and the formation of dry gray-brownish scabs. In the course of time the skin becomes thickened, stiff, wrinkled, and acquires the consistence of leather. When mange has spread over a large surface of the body, the animals lose flesh and become weak and anemic, rendering them constitutionally less able to withstand or combat the effects of the mites. At the same time the decreased vigor and lessened vitality of the affected animals

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favor the more rapid multiplication of the mites and the further extension and intensification of the disease. Thus we have cause and effect working together, with the result that scabies, or mange, in cattle may in some cases prove fatal; especially are fatal terminations liable to occur in the latter part of a severe winter among immature and growing animals, or those of adult age when in an unthrifty condition at the time of becoming infected. There have been noticed variations in the progress of the disease depending upon extreme seasons—aggravation in winter alternating with improvement in summer.

The mite which causes cattle itch, or mange, is closely related to the mite which causes sheep scab—both belonging to the same genus and species, but are different varieties. The sheep-scab mite will not attack cattle, nor will the cattle mite attack sheep or other animals. The itch mites are found to be very numerous upon affected cattle, and a very small quantity of débris from an actively infested area of the skin will often reveal a surprisingly large number of the parasites. These mites may be removed from an animal and retain their vitality for a long time. Specimens have been collected and kept in small glass bottles in the laboratory at the ordinary temperature of the room during the winter months, varying from 45° F. during the night to 80° F. during the day, which would live and remain active from eight to eleven days. Exposure to bright sunlight, however, would kill most of the mites in a few hours.

Scabies does not appear to affect cattle while they are doing well on grass, nor attack those in good condition over 3 years old. The animals which suffer most are calves, yearlings, and 2-year-olds, and those in poor condition. The first symptom of the disease is usually an intense itching of the skin about the neck or shoulders, and it extends more or less rapidly, depending largely upon the health and vigor of the animal, along the back and sides and down the outside of the legs, but does not usually affect the inside of the legs or the skin of the abdomen.

The other variety of this parasite which produces mange in cattle is the *symbiotes*. This is known as symbiotic mange, or tail mange. It remains generally localized upon the depressions on the back part of the croup and at the base of the tail. It may, however, extend over the whole surface of the body if the treatment of the disease and care of the affected animals are neglected. These cases, however, are rare. Foot mange is also exceptional in cattle. Tail mange has almost no spreading tendency, and its contagiousness is hardly noticeable. It yields readily to treatment, and any remedy that will destroy the activity of the parasite producing the psoroptic, or common, form of mange will readily kill that causing the symbiotic, or tail, mange. It is possible for the different morbid conditions produced by these two varieties of parasites to exist on the same animal at the same time.

FORM AND LIFE HISTORY.

The *Psoroptes*, the first variety referred to, live upon the surface of the skin, adhere to it, and suck the blood and lymph of the skin by means of their mouth organs, producing a more or less intense inflammation through the numerous stings which they inflict. This species is characterized by its relatively greater size. Its general form is rounded or egg-shaped. It can be seen with the naked eye upon dark surfaces, and is very easily seen with the help of a magnifying glass. The head is elongated and pointed. The jaws are long, straight, and stinging. The legs are very long. The sucking cups, tulip or trumpet-shaped, are carried on the legs. In the male they are seen on the four pairs of legs; in the female, upon the first, second, and fourth pairs only. The *Psoroptes*, or common mange mites, in their immature form have three pairs of legs, while in the adult state they possess four. The latter with five joints are fitted with suction cups covered with fine hair and armed with claws, or hooks. The head, thorax, and abdomen are not separated. The mouth parts are represented by mandibles, or jaws. The skin surface is covered with scales, hair, spikes, or silky hair, etc.

Females, which are larger than males, lay from 20 to 24 eggs; at the end of four to seven days the larvæ come out, and after having undergone three or four changes, arrive at the stage of reproduction from the fourteenth to seventeenth day. If exposed to damp air, or placed upon wet manure, the mange mites continue to live from six to eight weeks. Upon damp ground the eggs remain alive from two to four weeks. In a dry place they lose their vitality after four to six days. Moderate heat is favorable to their vitality and to the hatching of the mites.

In warm places under cover, and during the summer, their movements are more active and they multiply more rapidly than under the opposite condition. It has been estimated that one female alone may produce 1,500,000 individuals in ninety days.

Each animal species has its specific mange parasites, or mites; consequently, the expression "mange" must necessarily be incomplete unless the variety of the parasite is indicated. Thus, of the psoroptic variety, we have the ox mange mites, the horse mange mites, and the sheep mange mites.

In each of these animals we also have the symbiotic, or tail, mange, and in each the variety would be designated as in the case of the psoroptic, or common form; but in neither variety is the contagion transmitted from one species of animal to the other. The tail mange mites live especially upon the surface of the skin of the extremities, and exist in scabs in the outer layer of the skin. Their outlines are visible to the naked eye or with the magnifying glass. The head is short and wider than long. The body is slightly egg shaped and notched

upon the outer edge. The legs are long and the sucking cups are shaped like a Roman shield, and are distributed in both the male and female, as in the case of the same organs on the legs of the common mange mites.

Sarcoptic mange is a more serious disease than either of those already described, but is not common to cattle. It would not, therefore, seem important to refer to this form of mange parasite and occupy space in this bulletin except by a reference to the serious disease which is produced by this variety of mite through certain characteristics natural to them. We find Sarcoptic mange in the following domesticated animals: Horse, sheep, goat, dog, cat, and pig.

This variety dig galleries under the outer layer of the skin and live on the cells of the middle layer of the skin. They multiply in these galleries and occasion a very intense inflammation of the skin. Because of the depth to which the sarcoptes burrow, sarcoptic mange is exceedingly hard to eradicate. It would, therefore, seem fortunate that this form of the disease is not common to cattle. It is rebellious to all medication, and very frequently recurrences of the disease produced by this variety of mite are seen in other species of animals after treatment which has been prolonged for months.

TRANSMISSIBILITY OF MANGE.

Concerning the transmissibility of the different manges to animals and man, we find that all Sarcoptes may live for an indefinite period upon man's skin, but the common mange mites, the first variety described, and the tail mange mites, the second variety described, die very rapidly and occasion but slight irritations. The horse may contract sarcoptic mange of the sheep, pig, dog, and cat. The ox takes the sarcoptes of the horse, sheep, goat, and cat. The sheep contracts sarcoptic mange of the goat. The dog takes the sarcoptes of man, pig, cat, sheep, and goat. The pig contracts sarcoptic mange of the goat. From this it will be seen that sarcoptic mange, unlike the common and tail manges, is transmissible from one species of animal to another.

Mange is never developed except by contagion. The period of incubation—that is, the interval that lapses between the moment when the mites are deposited upon the surface of the body and the appearance of the disease on the skin—varies according to the number of mites transmitted. When in small numbers, the first manifestations of mange are sometimes seen only at the end of four to six weeks, while at other times the disease may be clearly apparent at the end of fifteen days. Contamination takes place either by direct contact—that is, immediate, as on pasture, at the stable, etc.—or by intermediary agents.

DISINFECTION.

What has already been said with regard to the contagious character of scabies in cattle—of the number of scab mites which may be found

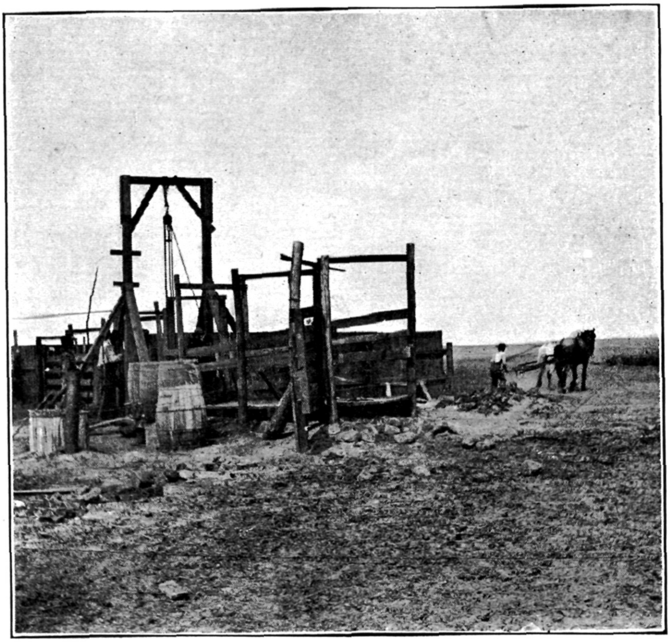

FIG. 1.—LANGEDAHL. RAISING CAGE LOADED WITH TWO YEARLINGS.

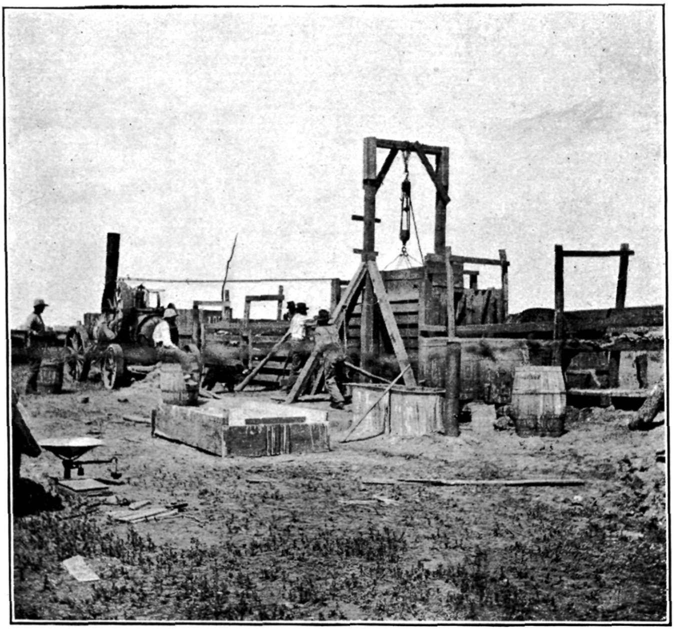

FIG. 2.—LANGEDAHL. STEER JUST LEAVING CAGE.

in a small quantity of the débris of the skin and their ability to live and remain active for a considerable length of time under unfavorable conditions—will indicate the importance of the thorough disinfection of corrals, sheds, or buildings in which affected cattle may have been kept. It is therefore necessary, in order to attain success in the treatment of this disease, to destroy parasites which have fallen off or have been dislodged from the animals, as well as those that are upon them; otherwise there is danger of their becoming reinfected from the premises after the effects of the remedy applied to the animals have disappeared.

TREATMENT.

Methods in operation for the treatment of scabies in sheep have become more or less familiar to all people interested in sheep husbandry, and it may be said that the same treatment so successfully applied in ridding sheep of scabies has been found equally efficacious in the treatment of scabies in cattle.

In 1898 the Bureau of Animal Industry issued Bulletin No. 21, entitled "Sheep scab: Its nature and treatment," which gives a description of this disease in sheep, its cause and treatment, with numerous formulas for the preparation of dips, and illustrations of the methods of applying them, together with directions for their use on both a large and small scale. The treatment of such large animals as cattle, which are difficult to handle, both because of their size and the conditions under which they live—the latter making them more or less intractable—would require a considerable amount of any preparation thoroughly to wet all parts of their bodies; next to effectiveness, therefore, small expense is the first object that must be considered. In the treatment of cattle for scabies, it seems fortunate that the dips of lime and sulphur, both of which are inexpensive, have proved effective and entirely satisfactory. During the past season thousands of cattle have been successfully treated for mange in the State of North Dakota, which work has been carefully investigated and observed by Dr. Robert H. Treacy, an inspector of the Bureau of Animal Industry, who has furnished diagrams and photographs of the various plants, and who states that the dip which has been universally used in that section is that designated in Bulletin No. 21 as the No. 3 South African (Cape Town) official lime-and-sulphur dip (February 4, 1897), which is as follows:

Flowers of sulphur	pounds	21
Unslaked lime	do	16¾
Water	gallons	100

Place the unslaked lime in a mortar box or some suitable vessel and add enough water to slake the lime and form a lime paste or lime putty. Sift into this lime paste the flowers of sulphur and stir the

mixture well. Be sure to weigh both the lime and sulphur, and do not trust to measure them in a bucket or guess at the weight. Place the sulphur and lime paste in a kettle or boiler with about 25 or 30 gallons of boiling water, and boil the mixture for two hours at least, stirring the liquid and sediment. The boiling should be continued until the sulphur disappears, or almost disappears, from the surface. The solution is then of a chocolate, or liver, color. The longer the solution boils the more the sulphur is dissolved, and the less caustic the ooze becomes. Most writers advise boiling from thirty to forty minutes, but a much better ooze is obtained by boiling from two to three hours, adding water when necessary. Pour the mixture and sediment into a large tub or barrel, placed near the dipping vat, and provided with a bunghole about 4 inches from the bottom, and allow it ample time (from two to three hours or more if necessary) to settle. The use of some kind of a settling tank provided with a bunghole is an absolute necessity, unless the boiler is so arranged that it may be used for both boiling and settling. An ordinary kerosene oil barrel will answer very well as a small settling tank. To insert a spigot about 3 to 4 inches from the bottom is an easy matter. Draining off the liquid through a spigot has the great advantage over dipping it out in that less commotion occurs in the liquid, which therefore remains freer from sediment. When fully settled, draw off the clear liquid into the dipping vat and add enough warm water to make 100 gallons. The sediment in the barrel may then be mixed with water and used as a disinfectant, but under no circumstances should it be used for dipping purposes. A double precaution against allowing the sediment to enter the vat is to strain the liquid through ordinary bagging as it is drawn from the barrel or settling tank.

The above directions are for the quantity of dip given in the preceding formula. Any multiple of the constituents may be used, depending upon the capacity of the boiler, vessels, and tank to be filled, but, let it be repeated, that there should be no guessing about the proportions; that the directions for the preparation of the dip as here given should be closely followed, care being taken that boiling be continued for the full time recommended, and that the sediment is not used for dipping purposes.

In order to attain success in the treatment of mange, care and thoroughness of method must be observed. Animals that have been exposed should be dipped as well as those that show distinct evidences of the disease. After the lapse of two weeks following the first dipping, the animals should be subjected to a second dipping, in order that parasites which may have survived the first treatment, or that may have gotten on the animals from corrals, sheds, buildings, or elsewhere may be destroyed. Several thousand cattle were carefully examined by our inspector forty days after being put through the dip

for the second time, and he failed to find evidence of scabies on any of them. These animals commenced to improve soon after being subjected to the first dip, as the dip killed lice as well as the scab mites, and owners of cattle adjacent to the dipping plants have declared their intention to dip in future years to kill lice, even if scabies does not exist. The dip liquid in the tanks during the whole dipping process should be kept at a temperature of from 102° to 110° F. Each animal should be kept two minutes in the dip, and be put completely under twice during that time. All bad cases should be hand-rubbed and kept in the dip four minutes.

Pregnant cows have been treated, as well as cattle of all ages, from calves to full-grown steers, with the loss of but one animal in one of the swimming tanks. This was a steer which for some reason seemed to be unable to swim and was drowned. It would appear that the dipping of cows has no appreciable effect upon abortions, as a comparison with previous years showed that the dipping had not increased the average number of abortions regularly occurring among these herds before dips were used.

DIPPING PLANTS.

Of the various dipping plants in use, there are but two kinds that need description—the small dipping plant, which is inexpensive and suitable for use by a community of farmers, and the larger dipping plant with swimming tank, such as would be needed if large numbers of range cattle are to be treated. A suitable plant for a community of farmers has been built for $150, while a swimming tank will cost $350.

Such a plant as that in operation 18 miles north of Steele, N. Dak., known as the Langedahl, would seem to be an admirable example of the smaller kind. This plant, with the exception of the tank, was built by farmers. A thrashing engine was used for heating purposes by connecting a 1¼-inch pipe to the whistle intake, the whistle being removed, and the pipe joined to the union. The plant has a capacity of 200 head per day. Its cost, without engine or labor, excepting the labor to build the tank or vat, was $150. One person can easily lower the cage when loaded by taking a hitch around a post, and it may be raised, as shown in illustrations, either with engine or horses.

MATERIALS FOR PLANT.

Following are the illustrations (figs. 1–15) and list of materials for the smaller plant, the tank of which may be filled with dip made as per preceding formula for about $7.50. The drawings from which the illustrations were made and list of materials were furnished by Dr. Robert H. Treacy.

Entrance pen and chute:

65 plank 2 inches x 6 inches x 16 feet.
28 posts.
18 braces 4 4 4

Tank or vat:

800 feet good 2-inch plank.
400 running feet tongue strip.
10 pieces 4 inches x 4 inches x 16 feet.
2 pieces 2 6 16
10 pounds lead.

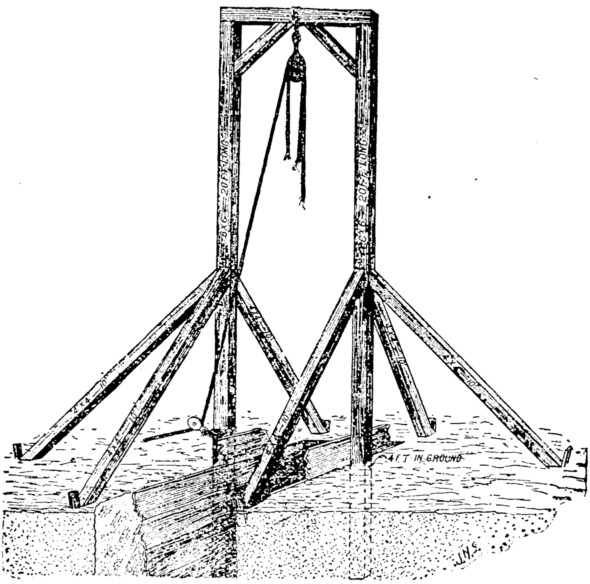

FIG. 1.—Derrick. Sixteen ft. high above ground. Derrick posts 4 ft. in ground, 6 by 6 by 20 ft. long. Braces 4 by 4 by 10 ft. long; 2 double-leaf 6-in. blocks at top of derrick, and 1-leaf 5-in. pulley at bottom of derrick; 100 ft. of 1-in. rope.

Cage:

8 pieces 4 inches x 4 inches x 16 feet.
8 pieces 2 4 16
12 pieces 2 10 16
10 pieces 1 10 16
4 half-inch iron rods, with ring in each end, 5½ feet long.
2 half-inch iron rods, with ring in each end, 4 feet long.
3 pairs of heavy hinges.

Derrick:

2 pieces 6 inches x 6 inches x 20 feet.
1 piece 6 6 10
6 pieces 4 4 12

Drip chute:

10 pieces 2 inches x 6 inches x 14 feet.
4 pieces 2 12 14
4 pieces 4 4 16
1 pair heavy hinges.
1 gallon tar.

Holding pen:
32 cedar or oak posts.
200 pounds wire.
5 pounds staples.

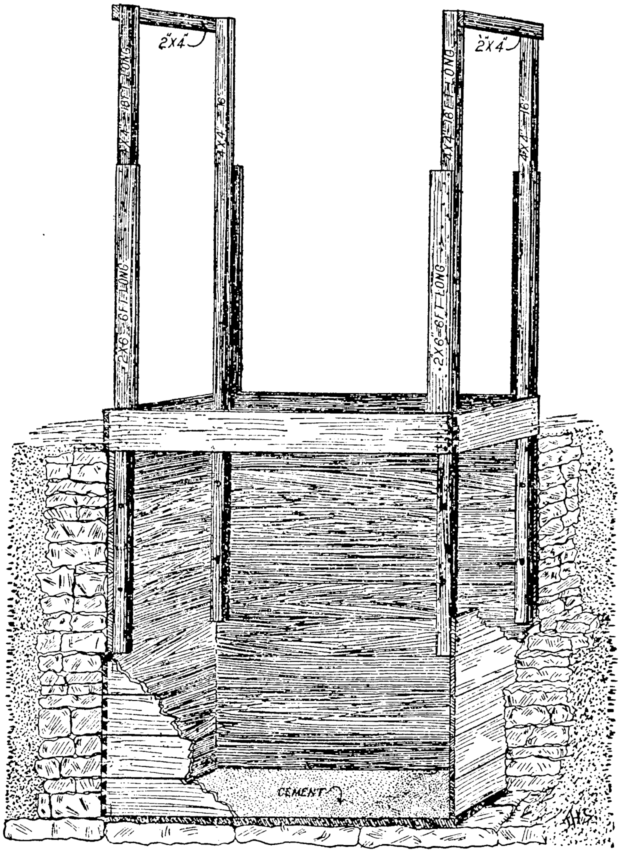

FIG. 2.—Vat. Tank 10 ft. deep, 4 ft. wide, 9 ft. in ground. Should contain from 5½ to 6 ft. of dip. Standards 4 by 4 by 16 ft. long, bolted to tank inside, to extend 6 ft. inside of tank, to act as guides to cage; 2 by 6 in. plank 6 ft. long nailed to outside of standards; 2 by 4 or 2 by 6 in. braces across top of standards. The tank should be built of 2-in. plank and joined with a tongue, the ends of the tank mortised in, the joints coated with lead. The braces are 4 by 4. The tank, being placed in the ground and packed solid, does not require much bracing. The tank should be laid in cement bottom, with stone and mortar about sides.

Hardware and incidentals:
100 pounds 20-penny spikes.
20 pounds 40-penny spikes.
2 6-inch double-leaf blocks.
1 5-inch single-leaf block.
100 feet 1-inch rope.
25 feet 1½-inch iron pipe.
1 galvanized-iron heating tank (5 barrels capacity).
4 oil barrels.

ADVANTAGES OF THE DIPPING PLANT.

A plant of this capacity will answer very well in a community where various owners have bunches of cattle ranging from 80 to 100 head or less. Among its chief advantages over the swimming tank are cheapness in construction, because of its size, and proportionately smaller

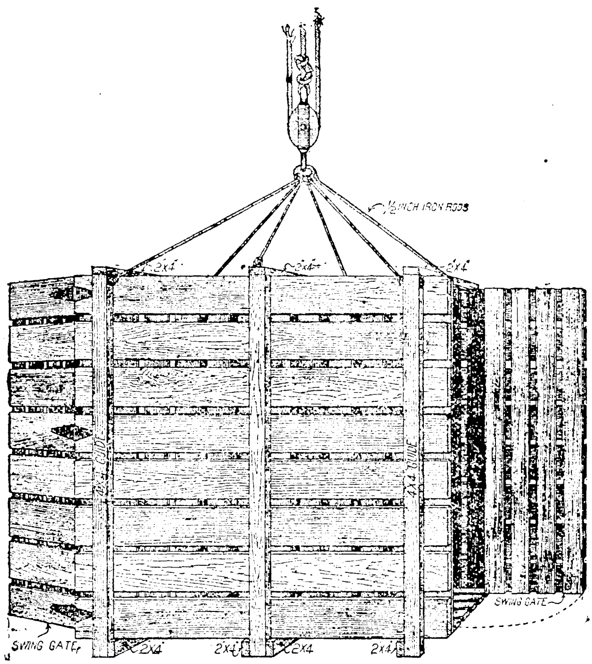

FIG. 3.—Cage. Eight ft. long, 8 ft. high, 2½ ft. wide—inside measurement; 2-in. plank used for outside, boarded up and down inside with 1-in. boards to keep animals from climbing up sides. Plank 2 in. apart. Inside boards 2 in. apart, and 1-in. cracks in floor to allow free escape of dip fluid.

expense in operating. The dip can be kept at the required temperature with facility, because of its lesser volume, and the submerging of the animals, as well as the length of time it is desired to keep them in the dip, can be more easily regulated.

In communities where mange does not exist, and where numbers of small herds are infested with lice, a plant of this character might be constructed and used with profit to the cattlemen. Many of the cattle that were dipped during the past year because of having been exposed to mange, or scabies, by being herded with those affected, showed much improvement in condition soon after dipping, as they were infested with lice to a considerable extent, although showing no dis-

tinct evidence of being affected with mange. It was observed that the lousy and mangy cattle stopped rubbing or digging after the first dip, and improved rapidly after being relieved of the torture that is inflicted by both of these troublesome parasites—scab mites and lice.

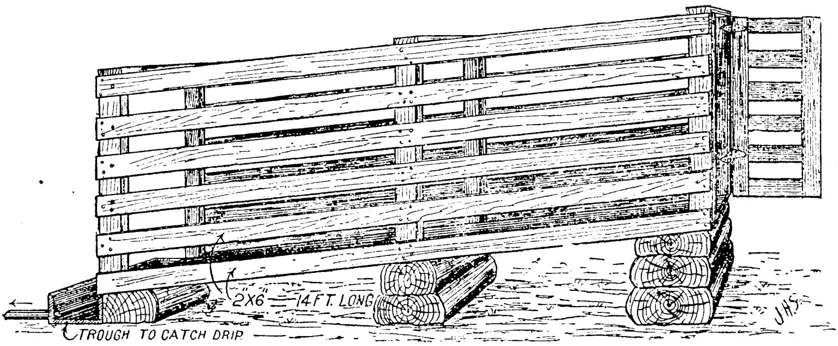

FIG. 4.—Drip chute. Fourteen ft. long; 2 by 6 in. plank; 5 ft. high. Set with 18-in. slope from front to rear. Trough at rear to catch drip, from which a pipe may be run to connect with tank to carry drip from drip chute back into tank. Floor of drip chute should be tight to prevent waste.

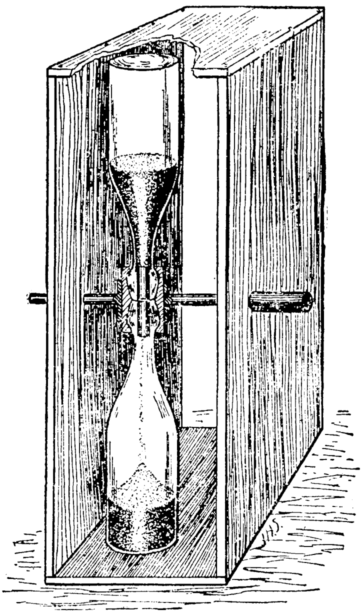

FIG. 5.—Sand glass, for timing the animals in the dip; is made of two ordinary ketchup bottles connected by a hollow wooden cork, placed in a box, and the box hung on a pin through the center to revolve, as shown in the illustration.

SPECIFICATIONS FOR LARGE DIPPING PLANT WITH SWIMMING TANK.

The following plans and specifications are for the construction of such a dipping plant as that of the Rice Lake Cattle Company, and

are in accordance with the drawings made for that company after the following specifications, made by A. Van Horn:

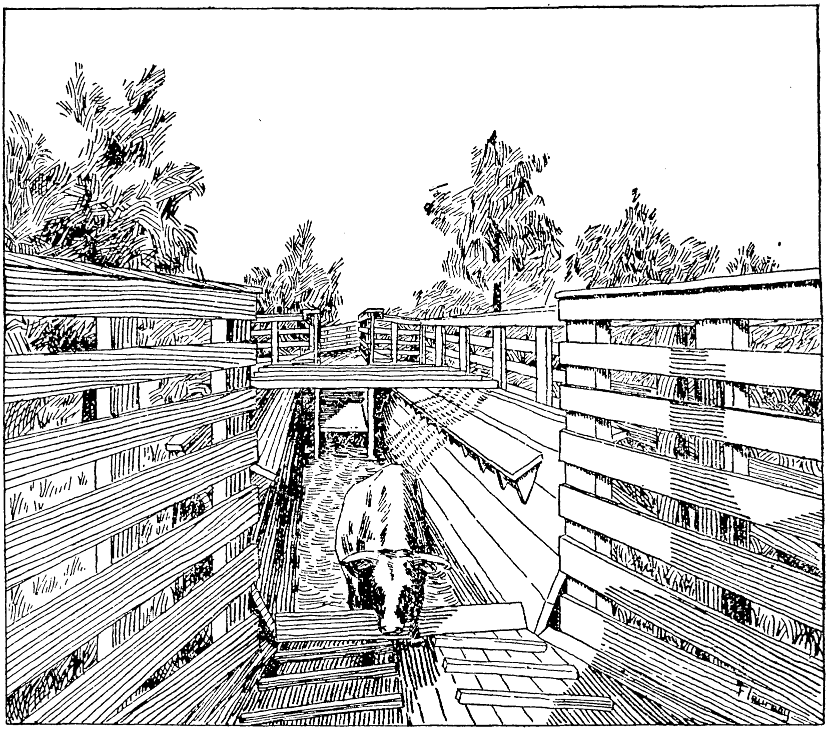

FIG. 6.—Steer emerging from dipping vat, or swimming tank, of large plant.

LABOR REQUIRED.

Excavations.—Excavate for the vat, as shown by the drawings, to the proper depth; level the bottom of the pit for the sills of the vat. After the vat is completed and the outside has been coated with coal tar, fill in around the vat, using the surplus earth to bank up and grade the sides of the vat above the natural grade, sloping the banks from the vat. Dig all holes required for the gate and fence posts.

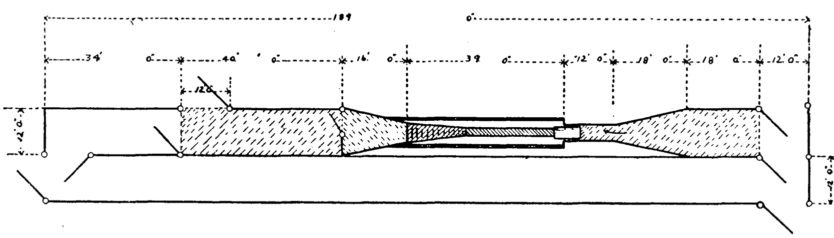

FIG. 7.—Plan of dipping plant, viewed from above.

Carpenter work.—All work must be done in a skillful and workmanlike manner; the framework of the vat to be bolted and spiked together; the plank of sides, ends, and bottom of the vat and dripping floor to have edges beveled for the calking as per detail, well driven together and well spiked with 20d. wire nails, using 40d. nails on

the 3-inch plank. Calk all seams with oakum, well driven in with a calking iron and pitched. The exit, or inclined end, of the vat to have 3-inch bottom plank; all other plank of the vat and dripping floor to be 2 inches thick. Top of vat to be tied with 4 x 4 inch ties across top, framed and bolted to uprights as shown. Put

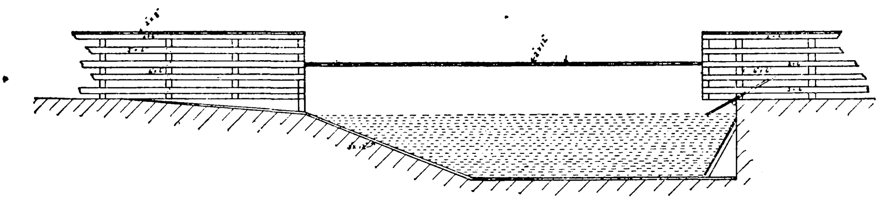

FIG. 8.—Vertical section of dipping vat, with older-style automatic trap on pivot. It will be seen that the incline at the bottom of the trap end of the vat is in a perpendicular line with the free end of the trap; where the spring trap is used, the length of the incline should be increased in order that at the bottom of the vat it may still be in line perpendicularly with the end of the trap when set; otherwise cattle are liable to get back under the trap, causing trouble.

2 x 12 inch splashboards on sides at top of vat, nailed to under side of tie timbers and braced. The exit end of vat and dripping floor to be cleated with $1\frac{1}{2}$ x 3 inch strips, well nailed to floor and bottom. Construct the trap at entrance—30 x 84 inches—of 2-inch plank, with 2 x 10 inch battens bolted together, top to be covered

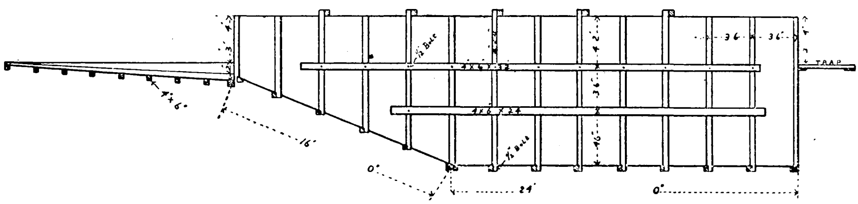

FIG. 9.—Side view of dipping vat, showing inclined egress and dripping floor.

with 14-gauge sheet steel. Trap to swing on a 2-inch wrought-iron pipe or 2-inch steel bar seated in the end of vat, with $\frac{1}{2}$ x 4 x 12 inch iron sockets bolted to vat. Secure the trap to the axle with iron straps bolted to under side of the center battens. End of vat to have false back as shown.

Gates and fence.—Construct and erect the gates and fence as per drawings.

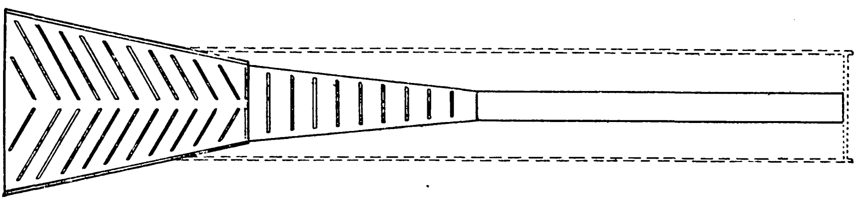

FIG. 10.—Swimming tank with incline and drip chute, looking from above.

The gate post to be set 4 feet in the ground and the fence posts 3 feet 6 inches. Set all posts plumb and to a line; well and thoroughly tamp the earth around the posts. The bottom of all posts to be coated with coal tar before being set. Gate posts to be 8 x 8 inches, with 6 x 8 inch tie framed and driftbolted to the posts. Fence posts to be 6 x 6 inches. The gates to be bolted and spiked together and

braced as shown. To be hung with ½ x 3 x 36 inch strap eye-and-bolt hinges. Bolt to run through posts and hinges bolted to gates. Gates to have ½ x 3 x 16

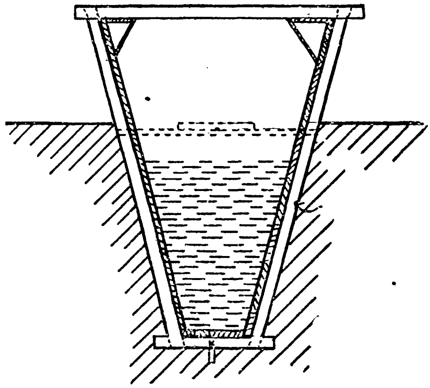

FIG. 11.—Vertical section of swimming vat, showing end of trap.

inch iron hasp bolted to gates and a suitable bolt staple, with iron pin and chain for locking.

Fence.—The fences to be five-railed, with cap, ribbon fence. Rails, or ribbons,

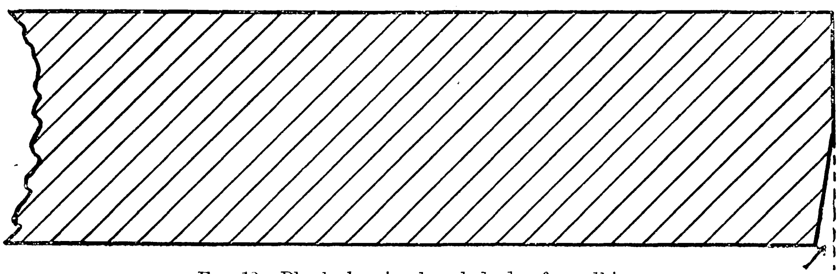

FIG. 12.—Plank showing beveled edge for calking.

to be of 2 x 6 inches, with 2 x 8 inch cap, spiked at each bearing with two 40d. wire nails. Posts to be set 8 feet on centers, or nearer where distance may require.

Lumber.—All lumber to be of No. 1 pine or fir dimension, free from shakes, bark,

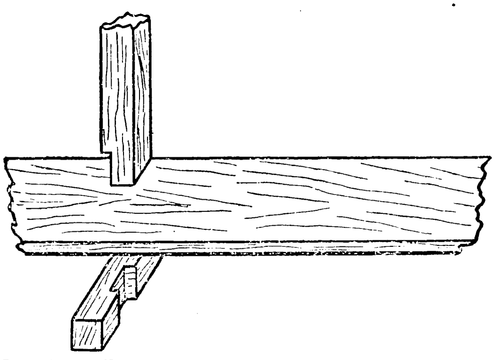

FIG. 13.—Sill and upright, showing method of joining.

large pitch pockets, unsound knots, or other imperfections that materially impair its strength, durability, and use for which it is intended.

Drainage.—The vat to have a 2-inch waste pipe fitted in the bottom with gate

valve and elbow, and 20 feet of pipe to run horizontally underground with a fall of 2 feet on 16 feet. At this point the owner will take up the drainage without

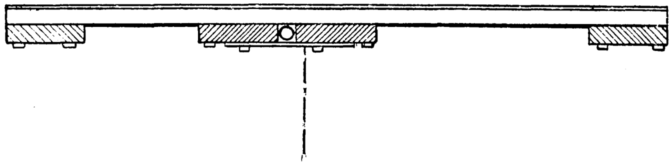

FIG. 14.—Vertical section of an older style of automatic trap, showing 2-in. iron pipe upon which trap is pivoted.

cost to the contractor, and continue the same to a suitable point either by pipe or open ditch.

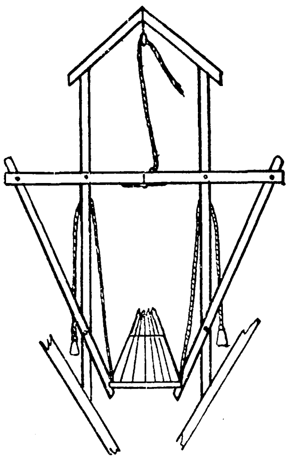

FIG. 15.—Spring trap set.

Dimensions of vat.—Perpendicular depth of vat to be 10 feet; width at top, 7 feet; width at bottom, 2 feet; length of level bottom, 24 feet; horizontal length of

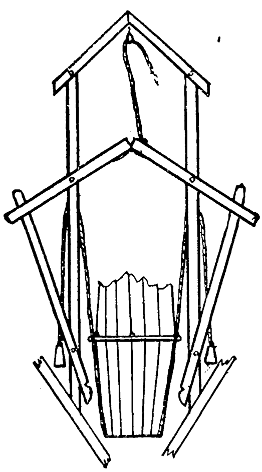

FIG. 16.—Spring trap sprung. This trap is hung on an iron rod or on a 2-in. iron pipe; weights are attached at the free end to pull it back in place; it then sets automatically.

sloping bottom, 15 feet; width of dripping floor at upper end, 12 feet; at lower end, 5 feet.

Floor pens.—Should the owner decide to floor the catch pen and holding pen No. 1, the floor will be of 2-inch plank nailed to 4 x 4 inch joist or sleepers, let into the ground and leveled. The sleeper to receive one coat of coal tar before being laid.

LUMBER BILL.

Vat and dripping floors:						
Plank for sides, ends	1,080 feet	= 30 pcs.	2″	x 12″	x 18′	No. 1 pine or fir.
False back and bottom	576	24	2	12	12	"
	64	2	2	12	16	"
	96	2	2	12	24	"
		or 3			16	"
	240	5	3	12	16	"
	72	2	3	12	12	"
Sills, uprights, and ties	24	1	4	4	18	"
	37	2	4	4	14	"
	64	3	4	4	16	"
	32	2	4	4	12	"
	27	2	4	4	10	"
	64	2	4	6	16	"
	336	21	4	4	12	"
	96	4	4	4	18	"
	21	1	4	4	16	"
	19	1	4	4	14	"
Splashboards	160	4	2	12	20	"
Cleats	54	9	1½	3	16	"
Trap	23	1	2	10	14	"
	30	1	2	10	18	"
Total	3,115 feet.					
Gates:						
Posts	896 feet	= 14 pcs.	8″	x 8″	x 12′	No. 1 pine or fir.
Tie beams	448	8	6	8	14	"
Ribbons	480	40	2	6	12	"
Braces	144	8	2	6	18	"
Battens or rails	96	6	2	6	12	"
	128	4	4	6	16	"
Total	2,192 feet.					
Fence:						
Posts	2,010 feet	= 67 pcs.	6″	x 6″	x 10′	No. 1 pine or fir
Ribbons	240	20	2	6	12	"
	140	10	2	6	14	"
	1,760	110	2	6	16	"
	450	25	2	6	18	"
Caps	64	4	2	8	12	"
	32	2	2	8	14	"
	469	22	2	8	16	"
	120	6	2	8	18	"
Total	5,285 feet.					

NOTE.—Oak or cedar posts are to be preferred. If round cedar posts are used, substitute 10-inch round posts for the 8 x 8 inch and 8-inch round posts for the 6 x 6 inch posts as above.

For catch pen.—There should be a plank floor in the catch and holding pen No. 1, but if only a limited number of cattle are to be dipped this may be omitted.

If it is decided to floor these pens the following material should be added to the foregoing lumber bill:

For holding pen No. 1	240 feet = 15 pieces 4″ x 4″ x 12′ No. 1 pine or fir.
	850 feet 2″ pine or fir plank, 12″ x 18′.
	240 feet = 15 pieces 4″ x 4″ x 12′ No. 1 pine or fir.
	960 feet 2″ plank 16′.
Total	2,290 feet of additional lumber.

Cottonwood lumber may be used where the market price of same would make it practicable.

SCHEDULE OF HARDWARE, ETC.

Vat and dripping floor:
- 42 carriage bolts, ½″ x 6″, with washers.
- 40 carriage bolts, ½″ x 8″, with washers.
- 18 carriage bolts, ½″ x 4″, with washers.
- 40 pounds 20d. common wire steel nails.
- 10 pounds 30d. common wire steel nails.
- 15 pounds 50d. common wire steel nails.
- 1 sheet No. 14 sheet steel, 30″ x 84″, with 1 gross 1″ No. 10 screws.
- 20 pounds oakum.
- 40 pounds pitch.
- 10 gallons coal tar.
- 5 feet 2″ pipe or steel bar for trap.
- 21 feet 2″ wrought-iron pipe, with couplings.
- 1 elbow, 2″.
- 1 flange for securing pipe to bottom of tank, 2″.
- 1 gate valve, 2″.

Gate and fence:
- 8 pairs eye-and-bolt hinges, heavy, ½″ x 3″ x 36″.
- 8 hasps, ½″ x 16″ x 3″, with bolt staple, for 8″ posts.
- 48 bolts, ½″ x 3″.
- 20 bolts, ½″ x 4½″.
- 68 bolts, ½″ x 6″.
- 160 bolts, ½″ x 4″.
- 32 driftbolts, ½″ x 12″.
- 20 pounds 30d. common wire nails.
- 65 pounds 40d. common wire nails.
- 16 gallons coal tar

NOTE.—If catch and holding pen No. 1 is to be floored, add to the above 30 pounds of 30d. wire nails and 5 gallons coal tar.

THE AMERICAN SADDLE HORSE.

By Gen. JOHN B. CASTLEMAN, *Louisville, Ky.*

PERIODS OF DEVELOPMENT.

Out of the needs of men grow the utilities of each age. Back in the days when the nation was young, and the hardiest of our heroes were beginning to go beyond the original thirteen States, the roads were few and bad. Even the paths were limited in number, and the use of vehicles was almost impossible. There was need of a peculiarly adapted horse, for of necessity the people depended upon horseback riding for long-distance travel as well as shorter trips. The horse that was wanted was one that could carry the rider with ease and not distress himself in the task. He was to travel long distances at a steady rate of speed; to be sure-footed; to be intelligent and tractable and hardy. This was the need; and out of the need came the ancestor of the magnificent American Saddle Horse. The ancestor was very different from the finished product of to-day.

In the beginning the horse was bred for use only; but as time passed the inevitable taste for luxury crept in. There came demand for beauty as well as utility, and the insistence on beauty has become more pronounced each year, and the developed American Saddle Horse has been the result.

Virginia and the South Atlantic States had given much attention to racing and were even then breeders of the Thoroughbred. The only other source of importation was from Canada. There they had raised a hardy little horse, said to be a cross of the French importations with generally such stallions as could be obtained from New York and New England. Whatever these Canadian horses were, they had some of the qualities required for man's comfort, and the Canadian had given much attention to the development of the pace, or "amble." Many of these horses were pacers; and our forefathers bred these Canadian mares to Thoroughbred stallions. After a while it was noticed that certain lines of Thoroughbred blood produced better results than others; and it is remarkable to note now how great saddle sires trace to the same origin. The horse that man needed as a saddle horse began to be produced.

The majority of the horses brought by the pioneer settlers of Kentucky were of this nondescript breed. They had no recorded pedigrees. Their breed had even no distinguishing name beyond the

indefinite designation of "saddlers." In the meantime the older States had been developing, and there the need for the "saddler" grew less as better roads were built and vehicles came into use; but in Kentucky and all the newer States the need for the riding horse was imperative.

And so it is that in all ages people adapt their transportation to the conditions which surround them, and gradually conform to the desire for increased comfort and luxury. In new countries the horse's back transports man and merchandise, and, as countries develop and roads are made and railroads built, the horse's back is relieved by the wheeled conveyance and his shoulders perform the duties which his back had previously rendered, till, finally, the steam engine does the work of transportation and lightens the burden of man's best friend. In the transportation of man and produce, the easier gait is at all times a necessity in most countries where the horse is primarily used, and the ambling horse has been utilized in many countries for several centuries. As means of cheap and easy transportation are multiplied and the necessity for the saddle horse is thus gradually diminished, there is a corresponding diminution in the necessity for easier gaits. When used for mere exercise of the master, any horse obtainable is put in use and is called a "saddle horse," as in all the world any horse used for driving is called a "road horse."

THE STANDARD, OR TROTTING, HORSE.

But we know the "road horse" as being that horse which has sprung chiefly from the loins of Rysdik's Hambletonian, the great progenitor of road horses, foaled in 1849, which in more than fifty years has produced a family distinctive in breed, in conformation, and in performance, and which we have come to recognize as the Standard, or trotting, horse. This horse, thus bred and trained, is known throughout the world as an American horse. We have in this country developed no great family of heavy horses and we have developed no family of small horses, but nature, and taste, and necessity, and conservatism have combined to bring into being that horse which all of these influences have presented to the world as an American horse, the result of American selection and American training. And now it is that he is carried to the Old World—for pleasure sometimes, sometimes for the stud; and as the strains of the older country are grafted upon this American production, a great horse is being propagated with a view to building there, as we have here, the type contributing to the pleasure of man.

THE ORIGIN AND DEVELOPMENT OF THE AMERICAN SADDLE HORSE.

Back beyond this Standard horse is an American family antedating by ten years the foundation of the trotting family, when there came

into Fayette County, Ky., a Thoroughbred stallion, foaled in 1839, called "Denmark." There was produced from this horse's progeny the great family of what we know as the American Saddle Horse. The sire of this Denmark was an imported English Thoroughbred, known as "Imported Hedgeford," foaled in 1825, brought to America in 1832. When Denmark was brought to Kentucky, he was bred to a fine and easy-gaited mare known as the "Stevenson mare," and this mare produced colts known as "Gaines's Denmark," "Rob Roy," and "Muir's Denmark." Gaines's Denmark, bred by careful selection, produced great stallions, and by continued adherence to type came the family as distinctive in conformation and manner and gait as is the Standard horse, differing somewhat from other horses, finer than any, and more useful than all.

The hereditary ability to learn the easy gaits of the saddle horse doubtless comes from the ambling horse, on which the Thoroughbred was originally crossed; but the tendencies of the American Saddle Horse need to be developed, just as the hereditary trotting tendencies need to be developed, and the hereditary tendency in either is manifest by training.

The American Saddle Horse and the Standard horse are nowhere else to be found. Both alike are American and entitled to the respect and consideration of the world everywhere. Sometimes it appears that the saddle-bred horse shows great speed in harness, and sometimes it is that the Standard-bred horse shows adaptability to the saddle, but these instances in either case are exceptional.

It very often appears that the saddle mare crossed upon the Standard stallion produces a great trotter. Generally it is that the saddle-bred stallion on the saddle-bred mare produces finish and beauty and utility useful under the saddle either in the roughest or in the easiest gaits, useful in light harness, and adaptable and beautiful always. The reproduction of uniformity of type is in no other breed of horses more marked than in the American Saddle Horse.

My personal intimacy with the most noted of this family of horses is altogether exceptional, for I have since early boyhood in my native county of Fayette, in the State of Kentucky, been personally familiar with and had personal acquaintance with the great sires and dams which have founded the Denmark family—deemed to be by all odds the greatest family of the saddle-horse breed.

I rode representatives of this breed during four years of the war, and served in a regiment and division whose mounts were generally similarly bred. It was with such mounts that this extraordinary regiment of men were enabled in repeated cases, with ease to the horse and ease to the rider, to make great marches in the rapid walk characteristic of this horse.

The characteristics of the race horse are dominant in this breed, and the absence of the fine eye, ear, neck, head, and shoulder are

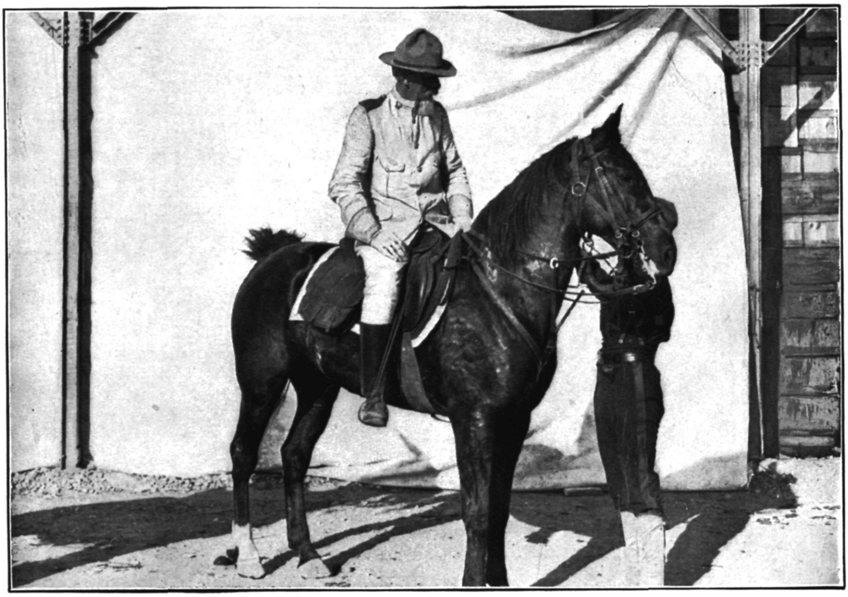

FIG. 1.—JOSEPHINE 1530 A. S. H. R. IN ARMY SERVICE IN PORTO RICO.

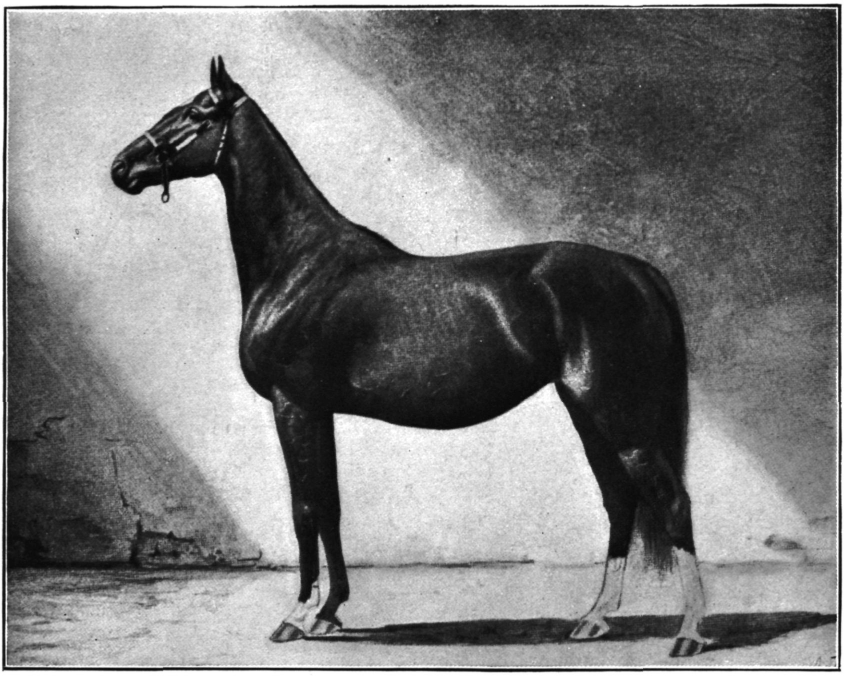

FIG. 2.—NEVILLE DAVIS 1733 A. S. H. R.

Emily 855 A. S. H. R.

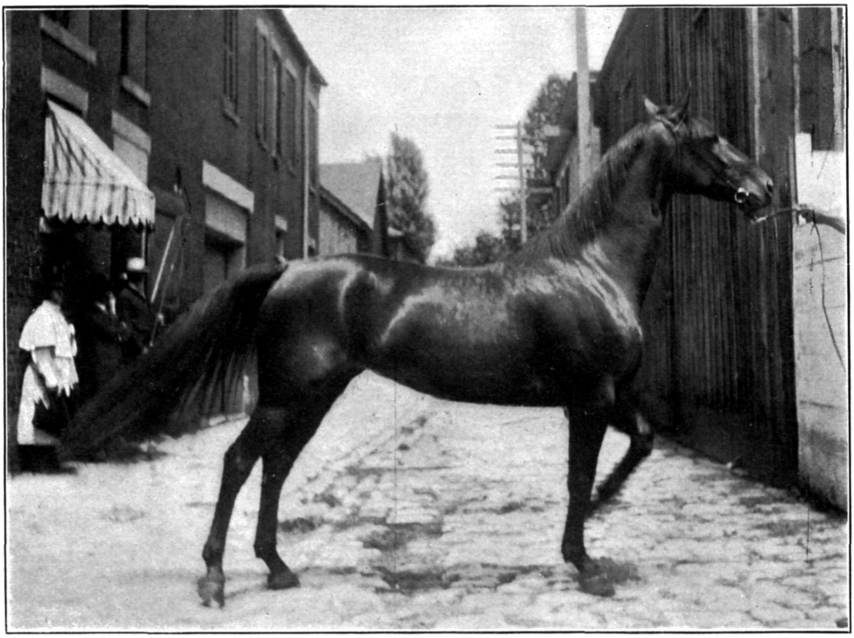

FIG. 1.—EMILY 855 A. S. H. R.

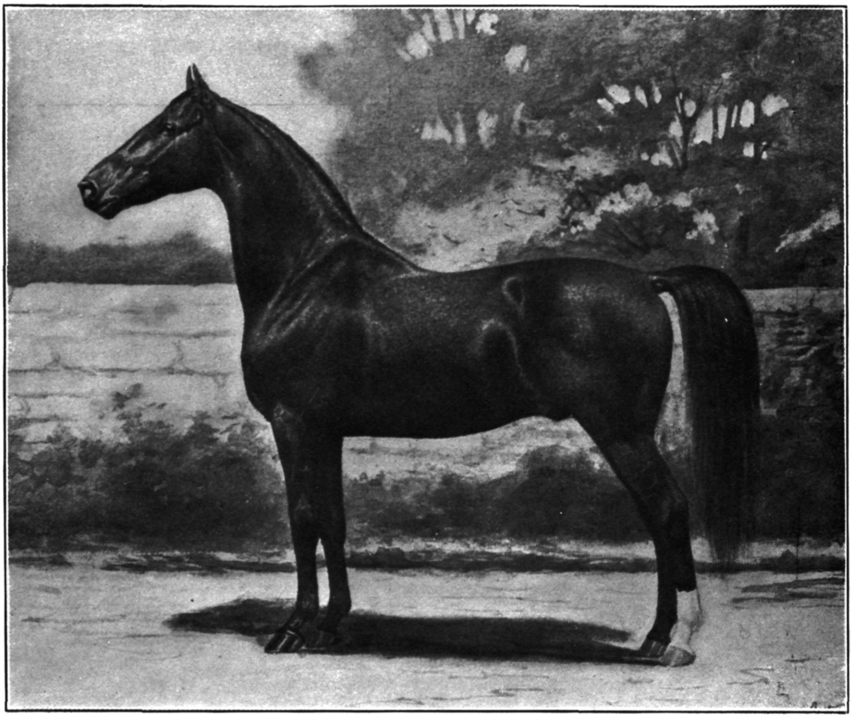

FIG. 2.—CECIL PALMER 933 A. S. H. R.

accepted as indicating the want of an infusion of such blood as flows through the veins of the best families of the gaited saddle horse. It has not been possible by crossing another breed to maintain or secure other than in exceptional cases that character, form, action, and life which mark distinctively the gaited saddle horse.

Personally I have, as a matter of experience, as numerous others have done, given trial to trotting mares and others crossed upon the best blood of the saddle horse, and while occasionally the progeny is all that one should want, there is no uniformity of result. A good infusion of the race horse, sufficiently filtered to impart the high quality and substance demanded for the saddle horse, and produced by careful selection and adherence to type, is found to be essential in obtaining the best results.

For the better protection of the saddle horse through adherence to a recognized type, there was organized in 1891 the National Saddle Horse Breeder's Association, and the register so provided has already had vast influence in the accomplishment of the ends desired. Better care in breeding has been stimulated and more rigid selections have followed. In 1893, when prizes were awarded in breeding classes at the World's Columbian Exposition, all saddle horses were required to be registered with this association as a condition precedent to competing.

There are other strains of horses used and chosen for riding purposes everywhere, but nowhere else, so far as I know, is there a distinct type bred or adhered to and designated as a breed of saddle horses. After the first volume of this register was printed in 1892, Col. John H. Ward, of Louisville, an able gentleman and an enthusiastic horseman, made a critical examination of the register and wrote me the result of this examination, using the following language:

LOUISVILLE, KY., *December 23, 1895.*

DEAR SIR: As requested, I send you herewith an outline of the Thoroughbred race blood of the 1,081 entries in volume 1 of the National Saddle Horse Breeders' Register: [a]

Thoroughbred	3
50 per cent Thoroughbred blood	50
25 per cent Thoroughbred blood	296
12½ per cent Thoroughbred blood	343
6¼ per cent Thoroughbred blood	152
3 per cent Thoroughbred blood	36
Uncertain	202

JOHN H. WARD.

JOHN B. CASTLEMAN, Esq., *Louisville, Ky.*

An examination of the second, third, and fourth volumes, and entries for the fifth volume, shows about the same ratio of Thoroughbred blood.

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[a] Name changed to American Saddle Horse Breeders' Association on April 7, 1899.

It is a matter of fact that the breeders of the American Saddle Horse have found it essential always to preserve and propagate a strong infusion of Thoroughbred blood, giving thus the finish, the courage, and the beauty which the cross with the Thoroughbred has been found to produce. And now since more than a half century's skillful breeding has thoroughly established the type, it is found that there is no horse anywhere whose characteristics are more certainly transmitted than those of the American Saddle Horse. Therefore it is that the stallions of the American Saddle Horse, judiciously crossed, produce horses of highest utility—produce the best horse for the range; produce the best cavalry horses that can be found in the world, having the greatest intelligence, the fastest walk, the easiest canter, and the clearest trot.

The civil war came and arrested the production of the American Saddle Horse. Stallions, mares, and geldings were sought for cavalry service; and with the end of the war came a craze for the Standard (trotting) horse. The high prices commanded for the trotter tempted even the most enthusiastic breeders of the saddle horse to stud their mares to trotting horses; and to this practice is now traced many of the greatest horses on the trotting turf.

When the studbook of the American Saddle Horse was published there were inserted as foundation stock (just as the foundation stock of the Standard horse is provided in his original studbook) stallions thought to be worthy of the distinction by reason of breeding and production. In most of these foundation stallions there was a strong admixture of Thoroughbred blood, and most of them traced their lineage to the great dam of Denmark, and possibly owe to this origin their reproduction of the American Saddle Horse.

Col. I. B. Nall, secretary of the American Saddle Horse Breeder's Association, wrote as follows on this subject:

When the association determined on this matter, the blood of the saddle horse had been too greatly dissipated in the effort to produce trotters and pacers for the track. Some of the saddle-bred mares had produced, when bred to trotting stallions, some of the best and fastest trotters, and the tide was fast turning in that direction. We find to-day a trotting cross in the pedigree of many of the fashionably bred saddle horses. Sometimes it is well; sometimes it produces a coarseness altogether unsuitable for our purposes, as a saddler for the show ring must, above all, be handsome and stylish. Breeders have found out where these experiments have proved disappointing, and now get away from them.

I am led to these conclusions by seeing a yearling, bred in royal saddle lines, exhibited at the Kentucky fairs this season, and winning in every ring in which he enters. I refer to the colt Goodwin 1227, bred by General Castleman, sired by Highland Denmark 730, and having as his dam the noted World's Fair winner Emily 855. Through his sire Goodwin gets the noted Denmark blood, as well as a dash of it through the dam's sire. He also gets the Dave Akin cross of Thoroughbred, a well-known "nick," and through his dam a John Dillard cross equally valuable. In this youngster is a concentration of the very best saddle blood, and through excellent specimens of the breed. A fine colt was looked for and expectations were fully realized. I shall not attempt a description here. It may not be

possible for every breeder to bring forth a sire and dam of so much excellence, but the nearer he approaches it, I think, the more profitable will be his venture.

We have heard of some fanciers decrying the attempt to maintain a register of saddle horses, seeming to believe that the start for a pedigree register must be by importation from some foreign country. Do they never stop to inquire how the breeds were established in such countries? Was not the breed of Jersey cattle made by careful selection and exclusion on the Channel Islands? Every class somewhere must have some such origin.

It may be said though that scrutiny of pedigree of the best saddlers will reveal in most cases that the blood of the Thoroughbred predominates. But while this is true, a breeder could make no greater mistake than to suppose that any Thoroughbred will do. He must look for his blood, and he will find that it is in the best form in the veins of the sires recorded in the register of the American Saddle Horse Breeder's Association. If breeding is confined to such, with care as to selecting individuality as well as prepotency, the future is safe. This course alone will enable us, when we want a saddle horse, to breed one.

FOUNDATION STOCK.

In 1891, after ten years of careful work, the American Saddle Horse Breeders' Association appointed a committee to report a revision of the foundation stock and extension and tabulation of pedigrees, and to comply with the recommendations made.

The list of foundation stock of this association was revised at the meeting of the stockholders in April, 1902. Some stallions heretofore in that list were removed and given numbers in the register for the reason, in some cases, that their sires had been admitted to the list since they were so admitted; in other cases it was thought that some of them had not a sufficient number of descendants in the register to entitle them to be continued in the list.

After revision, the list stands as follows:

Denmark (Thoroughbred) by Imp. Hedgeford.
John Dillard, by Indian Chief (Canadian).
Tom Hal (imported from Canada).
Cabell's Lexington, by Gist's Black Hawk (Morgan).
Coleman's Eureka (Thoroughbred and Morgan).
Van Meter's Waxy (Thoroughbred).
Stump-The-Dealer (Thoroughbred).
Peter's Halcorn.
Davy Crockett.
Pat Cleburne, by Benton's Gray Diomed.

Pedigrees of Denmark, etc.—Report of committee on extension and tabulation of pedigrees.

To the Members of the American Saddle Horse Breeders' Association.

MR. PRESIDENT AND GENTLEMEN: Your committee on the revision, extension, and tabulation of the pedigrees of the foundation and other important sires, begs to submit the following report:

In the case of Denmark, it was deemed advisable to pay him the compliment of extending his pedigree to the sixth generation. In all instances the effort to extend to the fifth generation was deemed sufficient, except where it seemed desirable to show some particular blood line.

In all work, clerical and other, errors will creep in, and this is the explanation of the error in the pedigree of Denmark as given in the first volume of the register of this association. The correctly tabulated pedigree of Denmark is submitted without comment, the committee believing that the heritage of fame brought this great horse by his posterity could not be brightened by any mere words.

In the case of John Dillard, the investigation of your committee leads to the conclusion that this horse was sired by Canada Chief, and it is recommended that Canada Chief be accepted as the sire.

Your committee was able to add but little to the pedigree, but it is extended on the dam's side in order to show that Lady Jackson, the dam of John Dillard, was out of a daughter of Blackburn's Whip, and he was by Imp. Whip, and he by Imp. Saltram. Now, Imp. Saltram got the Saltram mare, who was the dam of Jenny Cockracy, and she produced Betsey Harrison (dam of Denmark), and Susette,[a] who produced Berthune, the sire of Van Meter's Waxy.

In the case of Tom Hal, your committee is unable to add anything to what has been published in the volumes of the register.

In the case of Coleman's Eureka the most painstaking investigation fails to enable your committee to add anything to what has already been published.

Van Meter's Waxy is unquestionably a Thorougbred horse. On his dam's side, however, it is impossible to extend the pedigree. Mr. Ben F. Van Meter endeavored to aid your committee, but was only able to reaffirm the pedigree as given, and ascribe the inability to trace it out on the dam's side to the same short-sighted policy that seems to actuate so many saddle-horse men at the present day in their carelessness as regards pedigrees. Mr. Van Meter says there is no question but that Old Jenny was a Thoroughbred mare, and was left out of the studbooks with so many good horses at the time Mr. Bruce was compiling it. On the sire's side the pedigree of Van Meter's Waxy is most interesting. He was by Berthune (Th.), who was out of Susette, and Susette was a full sister to Betsey Harrison, the dam of Denmark.

Then Berthune was sired by Sidi Hamet, who was by Virginian, who was by Sir Archy; and Sidi Hamet was out of Lady Burton, who was also by Sir Archy. Now, Sir Archy was by Imp. Diomed, who sired Potomac, and he sired Jenny Cockracy, who was the dam of Betsey Harrison and Susette. Another interesting thing is that Sidi Hamet (the sire of Berthune) was out of Lady Burton, and she was out of Sultana, who was by Black Sultan (known as the Jefferson Barb horse), and out of the Jefferson Barb mare.

Of these two Barbs, the American studbook says, in substance: "Sent as a present from the Bey of Tunis by the hand of his ambassador, Melli Melli, in the year 1806, to His Excellency Thomas Jefferson, then President of the United States, and assured by the said ambassador to be two of the highest-bred horses in that country, and selected at very considerable expense and with great care as a present worthy of his acceptance. They were sold for the benefit of the United States after the departure of Melli Melli."

Among others, the Jefferson Barb mare produced a filly by Black Sultan, called "Sultana," who was the dam of Lady Burton by Sir Archy, one of the best brood mares this country has ever produced. As has been said, this Lady Burton was the dam of Sidi Hamet, who got Berthune, and he sired Van Meter's Waxy.

Your committee is unable to add anything to the history already published of Cabell's Lexington.

Stump-The-Dealer is a Thoroughbred, recorded in the American studbook, and his tabulated pedigree is herewith submitted. He was by Imp. Bryan O'Lynn,

[a] This name is spelled both "Susette" and "Suzette" in the Register (Vol. IV), but the first method prevails and is adopted here.—ED.

who was by Aston, who was by Saltram. Now, Saltram sired the Saltram mare, and she produced Betsy Haxall, who produced Aratus, and he sired Betsey Harrison (the dam of Denmark) and Susette (the dam of Berthune, who got Van Meter's Waxy).

The Saltram mare was also the dam of Jenny Cockracy, who produced Betsey Harrison and Susette.

Then Stump-The-Dealer was out of the Grey Diomed mare, who was by Grey Diomed, and he by Imp. Diomed. Now, it will be remembered that Imp. Diomed got Sir Archey, to whom Berthune, the sire of Van Meter's Waxy, twice traces. And also Imp. Diomed got Potomac, who sired Jennie Cockracy, who was the dam of both Betsey Harrison and Susette.

The second dam of Stump-The-Dealer was by Symmes's Wildair, who sired the dam of the Saltram mare, and also sired Director, who sired Aratus, and he sired both Betsey Harrison and Susette.

To the personal history of Stump-The-Dealer, your committee is able only to add that he was owned and run in Tennessee, and his dam was owned by Colonel Alston, of South Carolina.

Peter's Halcorn was by Virginia Halcorn, who was by Virginian, who was by Sir Archy; and so again we catch this blood. His pedigree is extended on the sire's side to the fifth generation for the purpose of showing this cross. No information in relation to his dam was obtainable.

David Castleman,
William A. Gaines,
I. B. Nall,
Committee.

Pedigree of Denmark.

Denmark, F. S.	Imp. Hedgeford	Fihlo-da-Puta	Haphazard	Sir Peter — Highflyer.
				Papillon.
				Miss Hervey — Eclipse.
				Clio.
			Mrs. Barnet	Waxy — Pot-8-os.
				Maria.
				Daughter — Woodpecker.
				Heikel.
		Miss Craigie	Orville	Benningbrough — King Fergus.
				Daughter.
				Evelina — Highflyer.
				Termagant.
			Marchioness	Lurcher — Dungannon.
				Vertumus.
				Miss Cogden — Phenomenon.
				Daughter.
	Betsey Harrison	Aratus	Director	Symmes's Wildair — Imp. Fearnought.
				Jolly Roger Mare.
				Eclipse Mare — Harris's Eclipse.
				Daughter.
			Betsey Haxall	Imp. Sir Harry — Sir Peter Teazle.
				Matron.
				Saltram Mare (Timoleun's dam.) — Imp. Saltram.
				Daughter.
		Jenny Cockracy	Potomac	Imp. Diomed — Florizel.
				Sister to Juno.
				Fairy — Pegasus.
				Nancy McCullock.
			Saltram Mare (Timoleun's dam.)	Imp. Saltram — Eclipse.
				Virago.
				Daughter — Symmes's Wildair.
				Daughter.

The following hitherto unpublished communication of the distinguished writer, John H. Wallace, will doubtless attract widespread attention, even from those who do not altogether agree with his views.

Mr. Wallace's main point appears to be that no matter what made the prime elements of the American Saddle Horse of to-day, it was not the Thoroughbred. I take the opposite view from this, and I do so

from an experience in the making of the type of the American Saddle Horse, going generations back of the formal and systematic effort to form that type under Standard test. And I have memories in relation to this subject, gathered in touch with horsemen who, before my early days, knew of Kentucky's association with this order of horse and never thought of it separate from the Thoroughbred.

The Thoroughbred runner can assuredly do nothing but run; but his stock grafted on other stock has produced many of the best representations of the American "Standard horse" and lies at the very foundation of the American Saddle Horse. With Mr. Wallace's views as to the foundation of the Thoroughbred we have no concern in respect of this article. It will not do, however, to confuse the saddle horse of ancient times with the beautifully finished product which has resulted from scientific breeding.

I have no theories on this subject originating apart from what I have just stated. I but know of the facts as here I have found them, and if the theory and the fact disagree, so much the worse for the theory. It is not necessary to go into ancient history to learn of the controlling blood in our present-day typical American Saddle Horse. It is the plain truth, not to be lost sight of, that he is the product of breeding of the selection, generation after generation, of the fittest for the purpose in mind, just, for instance, as is the English hunter. Every source of supply of material helpful to the end sought has been drawn upon. Do away with this principle of selection, by which it is insured that the power of the fittest counts immediately and without waste, and the intelligence of the guiding hand that goes with it, and there is reversion.

The following is the letter from John H. Wallace:

NEW YORK, *December 13, 1895.*

Gen. JOHN B. CASTLEMAN,
Louisville, Ky.

MY DEAR SIR: Your welcome letter, with the first and second volumes of the American Saddle Horse Register, came safely to hand last week. These volumes of the register make it evident that the movement to establish the American Saddle Horse as a breed has been successfully inaugurated, and if intelligently carried forward will end in the achievement of the object in view. To this end I will gladly give you any assistance in my power.

A hasty examination of these volumes suggests two or three points that I will here mention without further comment.

First. Why are the animals selected as your foundation stock practically limited to the State of Kentucky? It is certainly true that the States of Ohio, Indiana, and Tennessee, to say nothing of some others, abound in old strains of pacers that might be included. Second. Why have we not something of the origin and history of Cockspur, the sire of the dam of Gaines's Denmark and the sire of the grandam of John Dillard? It was his blood that made the Denmarks a family of saddlers instead of runners, and I think he was the sire of the grandam instead of the great-grandam, as you have it, in John Dillard's pedigree. Third. Some sixty or more years ago it became a common practice to speak of every pacer as a Canadian, and of every good shapely horse, when nothing was known of his breeding,

as a Thoroughbred. Unfortunately this kind of fantastic history and genealogy is still prevalent, and is to be found in greater or less measure in some of your foundation stock. You can rest assured that we are not indebted to either the Canadian or the Thoroughbred for any of the essential factors going to make up the American Saddle Horse.

For the past year I have been devoting a great deal of time to the history and characteristics of the American horses of the colonial period. These researches have not been restricted to one or two colonies, but they have been extended to all on the Atlantic coast, except South Carolina. This is a field of exploration that I think is entirely new in horse history, and it extends from the first arrivals of horses in the different colonies up to the war of the Revolution. All the horses in all the colonies were brought from England, except those in New Netherlands (New York) and two, or possibly three, shiploads that were landed in Salem, Mass., from Utrecht, in Holland. These Dutch horses were larger and stouter than the English horses, some of the largest ones reaching 15 hands, and sold for higher prices on account of their greater strength, but they were not so highly prized for the saddle. They were not pacers.

From the beginning it was the custom in all colonies to brand the young stock in the spring and turn them out to find their own living till autumn drove them home. In the first half of the last century newspapers, so called, were established in many of the colonies, and one of their chief sources of advertising patronage was for horses "strayed or stolen" or "taken up." In these advertisements the age, sex, color, size, gait, and brand were generally given, and thus by taking a file of one of these papers and carefully collating all the points here indicated for a given period, we have sufficient data upon which to strike a safe average as to height, colôr, and habit of action. In Pennsylvania nearly all were pacers and gave the lowest average in size. In Virginia about two-thirds were pacers, with next lowest average in size. In the New England colonies the average of pacers was about the same as in Virginia, with an average of height somewhat greater, showing the influence of commingling with Dutch blood. About the time of the Revolution the Dutch horses of New York still maintained their preeminence in size, but in crossing with the English horses to get the saddle gaits nearly or quite one-half of them had become pacers. It may be remarked that between the earlier and later observations there was a steady increase of size, rising from about 13 to 14 hands, resulting from more careful selection and backed up by colonial regulations, forfeiting to the finder any stallion colt of two years or upward found running at large.

In 1665 Governor Nichols, the first English governor of New York, established the Newmarket course on Hempstead Plains, Long Island, and provided for meetings there every year. This was the first regularly organized racing in this country, and it was kept up, spring and fall, with some intervals, for more than a hundred years. Virginia had been racing before this, but I think there was no organized racing there till a few years later. The distance for the best purse on the Long Island course was two miles in heats, and the distance at the Virginia meetings varied from one to four mile heats. Now, all this was going on for nearly or quite one hundred years before the first English "Thoroughbred," as we call them, was brought to this country. Up to the year 1750 the fingers on one hand would cover all the Thoroughbred horses that had been brought to this country.

They were the ancestors of the American Saddle Horse that ran these races, and they were brought to this country before there was any infusion of Saracenic blood into the English saddle horse. It is historically certain that the saddle horses of the middle of the twelfth century ridden by the nobility and gentry of that day were pacers. The trotters were assigned to their esquires and other

attendants. This is the historical pedigree of our American Saddle Horse, and I can see no reason to be ashamed of it. Those English saddle mares that could run as well as pace fast were the real foundation of the English race horse, just as their descendants of a later date were the real foundation of the American race horse.

* * * * * * *

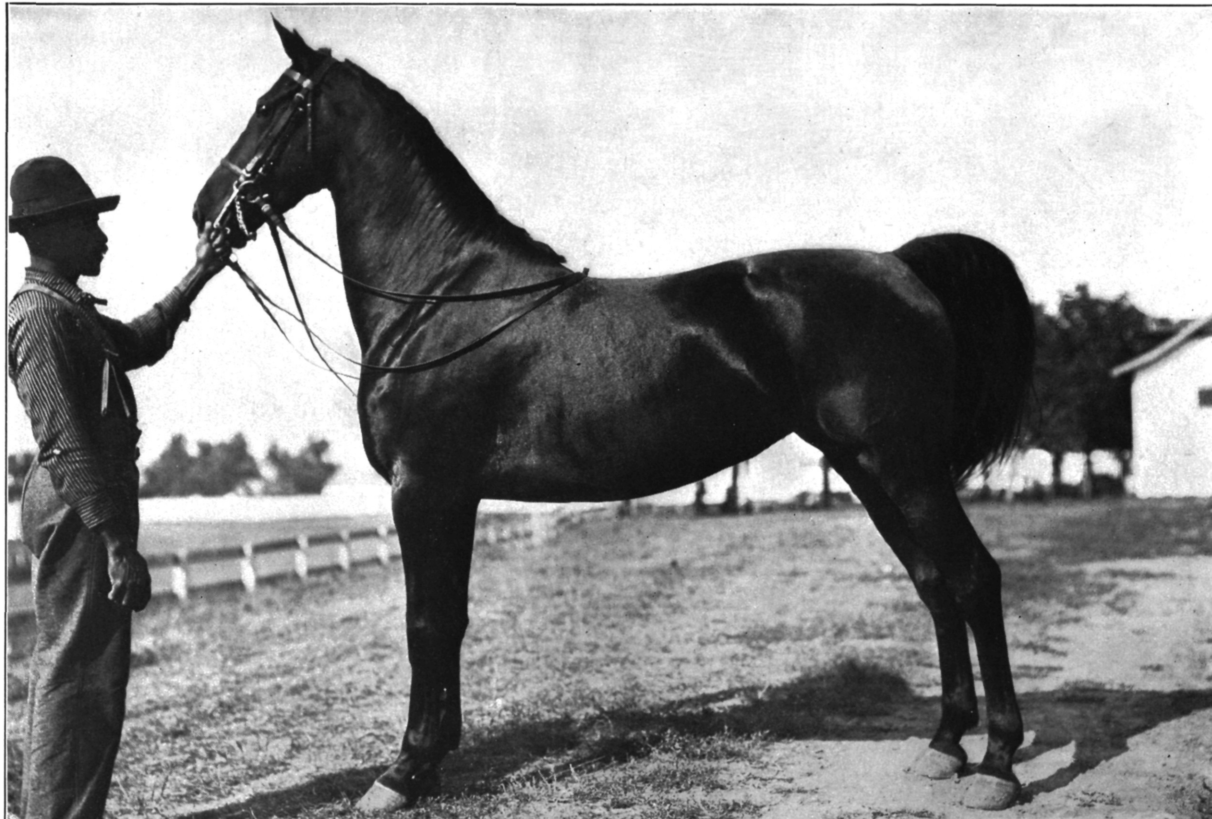
When I commenced to think and write about the horse fifty years ago, like all other beginners of that day, I was as wild as a hawk. I was terribly afflicted with the parrot cry of that age, that the way to improve the horse or any other domestic animal was to "breed up," and I never got clear of my affliction till I sat down to the study of great collections of facts. It did not then take me long to learn that mere "breeding up" was a delusion and a humbug, and that the true way to breed was to go to the horse that possessed the qualities and could do what I wanted my colt to possess and do. In other words, [adopt] the simple formula that "like begets like." In looking back over the acts of a long life, I think if I have done anything that may live after me, it is the promulgation and support of this great central truth as applied to breeding horses. It met with much and bitter opposition for a long time, but it has now become "the law of the land."

Col. M. Lewis Clark, breeder of the Thoroughbred and a great equestrian and accomplished horseman, writing in December, 1897, in the Breeder's Gazette, used the following language:

The intelligent student of breeding first selects, by careful analysis of the stud book and racing record, the different families of blood he desires to make, and then seeks by individual study to remedy the defects in conformation of the one by the qualities presented by the other. A ride in the park of a few miles for pleasure is one thing and a seat in the saddle from sunrise to sunset is another. The park rider accepts the dictates of fashion because it is so, while the latter from necessity seeks to discover and enjoy what is proved to be a comfort to the rider and least discomfort of fatigue to the horse. Nature and science both suggest that in agriculture, as well as in other pursuits, there should be some diversity of crops—some change or rest. * * *

Few travelers going a distance but would thoroughly appreciate the comfort derived from using the educated saddle horse; and by that is meant a thoroughly trained one, capable of changing at the will of the rider to any desired gait, commencing with a square walk, going into the run-and-walk, or fox trot, then into the trot, changing into a canter, and going by a gentle pressure of the bit into a rack. The latter is an essentially made gate, though seemingly transmissible in the present time from different families that for many years have been inbred and to which the work of education seems to be but little work and entirely a pleasure.

Of course, with the work of years, it was marvelous to note what perfection was reached, and the traveler through Kentucky and Tennessee on the county court days would see hundreds of these gaited horses hitched around the courthouse, and the encouragement of this industry was coexistent with that of the harness horse. Wherein the superiority of the gaited saddle horse over what is called the "park, or Eastern horse," is simply that the trained saddle horse, at the will of the rider, can do all that the other can do and more, insuring comfort and ease to the rider and rest to himself by reason of the change in gaits, while the other horse has but the walk, trot, and canter or run, and can do none of the easy gaits of the trained saddler. It is well to remember that in the development of the trained educated horse the different gaits are simply accomplishments to be used at the will of the rider and are not obtrusive in any way—simply an ability to be called on when desired. Our sons and daughters are taught many



Florida 1945 A. S. H. R.

Brenda 1753 A. S. H. R.

accomplishments before they are supposed to be finished in their education—accomplishments which many of them never use after they complete their education, but are still capable of exercising at will. To sum it all up the high-bred gaited saddle horses of Kentucky and Tennessee furnish to the lover of such exercise a perfect type, which has been the result of careful study stimulated by necessity, and a result obtained only by scientific breeding, which has produced an intelligence that can be taught anything. In case the rider does not desire to take advantage of the horse's education, then his own judgment can use the gaits at will. * * *

In giving you the highest degree and development of the saddle horse and of his accomplishments, in each of which he is distinctively superior, we will still cling to a deep-seated belief, borne out by facts and without prejudice, that it is a distinct type that has evolved as the result of a necessity. The combined saddle and harness horse of intelligence, courage, and gentleness for general utility is really two horses in one, and is the natural result of breeding, companionship, and careful training. It takes a few generations to furnish a satisfactory result in any line of breeding, and therefore this carefully selected type is equal to responsibility, safe in accident, and a gentleman in his manners, being educated, and having graduated with all the accomplishments. Just look over a blue-grass woodland pasture, and see a lot of these well-bred youngsters in their play. Beauty, style, and action are combined with courage and intelligence, and it takes but little schooling to make them illustrate thoroughly that they are the standard of the horse that will carry weight and go a distance.

A breeder, contributing to the third volume of the American Saddle Horse Register, and writing of the American Saddle Horse, says:

The first requisite to be considered in a saddle horse is the quality of being sure-footed; the second, that of a kind disposition coupled with a good mouth; third, courage and ambition; fourth, the conformation of a weight carrier; fifth, gaits and manners. Neither the first qualification nor the order in which it is placed will be disputed. No stumbling horse should ever be mounted. Almost every person who has seen a horse knows the meaning of a kind disposition to a certain extent, and none can possibly appreciate it more than a rider. The saddle horse should by all means have a level head, and no one thing has tendency to produce this more than a good mouth. When drawing in the reins on a start, there should be a perceptible yielding of the lower jaw, followed by a steady pressure willingly given in such a way that the rider may at all times "feel" the horse's mouth, and the absence of a desire to pull or lug should be marked. The mouth is many times the root of all evil, and the thought of its influence upon the horse's disposition should never leave the rider's mind.

In explanation of the third qualification: By courage is meant spirit, pluck, and endurance; a desire to go just as fast as the rider may wish and no faster, and this without encouragement from whip or spur. The ability to do this is possessed by all educated saddlers as they learn to know their rider's silent signal.

Fourth, to carry weight a horse must possess a strong level back. He must be closely coupled, legs well muscled, oblique shoulders, the hind quarter heavy, with tail set on well up. A horse with a good back rarely exceeds 1 inch higher at the withers than at the quarters. To use a common phrase, his outline should be that of a big little horse.

Fifth, there will always be a difference of opinion as to the order in which the last two qualifications have been given. Many will contend that the manner in which the horse performs at the different gaits should be considered before the horse as an individual. The all-day-and-all-week rider will first look at the horse in repose. Conformation being first acceptable, each gait must be well defined

and willingly performed, the general manner being marked with dash and boldness. The single foot, or rack, should not have the side motion in either feet, legs, or body. The trot should be springy and even, with plenty of knee action, but not too high. The canter should be slow, with no increasing speed, and the horse be taught to lead with either leg at the command. The flat-footed walk should be reasonably fast with no amble or swing of body. The running walk, or fox trot, should be equal to 5 miles an hour. These requisites are found in the American Saddle Horse to a degree not possessed by any other horse in the world.

The Thoroughbred is not and can not be made a good saddle horse. His action is different from that of the saddle horse; his stride is not easy, his temper is often objectionable, but by proper selection there has been produced in the family of American saddle horses the most desirable characteristics of the Thoroughbred. We have, in addition to the finish and courage, his ear, his eye, his shoulder, his coupling, his clean, hard legs.

The Breeder's Gazette says:

Rarely is a case more tersely and convincingly stated than in this indictment against the Thoroughbred as a saddle horse, made public by Charles L. Railey, whose winnings of premiums with saddle horses at the prominent Western and Eastern shows classes him as one of the most successful saddle-horse educators in the country:

"Much was said and written about fixing the type of saddle horses in the National Horse Show last fall, many contending that the English expert had thrown no light upon the subject by his awards at the Garden. Rider and Driver quoted the Englishman as leaning toward the Thoroughbred as the best type, but since it takes many other qualities, characteristics, and graces besides conformation to round out the saddle horse, the query becomes pertinent, Can these be found in the Thoroughbred? My answer is, No. And for many reasons:

"First, he is too hot of temper, having since his creation been trained and taught to do but one thing—that is, go (run); therefore, under restraint he frets, fumes, yaws his head; then one's ride for pleasure or exercise becomes a work of labor.

"Second, the Thoroughbred fills the eye to look at from the ground; on his back he is all wrong. His neck is rigid and can not be flexed into good form; as a rule he is higher over the hips than over the withers, which gives the rider a sense of pitching forward or riding down hill, as it were. He has but little flexion of the knee and hock, and this close-to-the-ground action on the walk or trot causes him to trip more frequently than any other breed of horse. In a life experience I do not recall one high-class saddle horse that was strictly a Thoroughbred. I have bought many beautiful specimens of the Thoroughbred, and tried faithfully to develop a saddle horse, only to find disastrous failure in each instance. The Kentucky breeder long ago realized that the Thoroughbred horse was the foundation from which to build for fineness of head and neck, obliquity of shoulders, texture of coat, quality of bone, and fluted leg. And while retaining these qualities, add to them a higher carriage of head, more action, a more docile temperament, and from this idea was evolved the saddle-bred horse of Kentucky. There is no question but that the far-sightedness of the Kentucky breeder produced the most beautiful horse known in all the world."

This comes from a man who is himself a breeder of Thoroughbreds, and therefore no possible animus can be charged. It is merely a statement of facts known to every man who has taken the trouble to acquaint himself with the subject.

Rarely has such success attended the efforts of breeders bound together in endeavor by a common ideal as has characterized the work of the organized breeders of the American Saddle Horse. All this talk of establishing a type of saddle horse in this country is mere waste of words. A half century of breeding for a specific purpose has already established a type. Our best markets years ago recognized that type, and bought it at the highest price ever paid for saddle horses. Only those who come new to the game, or a few Rip Van Winkles in the horse world, are unaware of this fact. Mr. Railey has ample reason for saying: "I shall continue to develop and exhibit this type; it dominates the show ring, commands the top price, gives satisfaction."

The organizers of the American Saddle Horse Breeders' Association, who, through thick and thin have stood out sturdily for the type, have laid users of saddle horses under a burden of enduring obligation to them for their systematic efforts to preserve, purify, and perfect the blood on which this great horse, the handsomest in the world and the most intelligent, is founded.

THE AMERICAN SADDLE HORSE AS A CAVALRY HORSE.

The history of cavalry service shows no parallel to the continuous fast movement of the cavalry under Morgan and Forest, and this service was rendered chiefly by the American saddle-bred horse; and this horse of singular beauty and smooth, fast walk and untiring energy stood the terrible strain where horses of other breeds gave way under test of great marches.

It was not unusual to have these saddle-bred horses last through the four years of the Civil War, and it is a notable fact that one of the great progenitors of this breed of horses, Gaines's Denmark, entered the Confederate service at an advanced age, served two years with his descendants and collateral horse kin, setting his numerous offspring an example of courage and endurance, returning in 1865 to his original owner, honorably discharged as a soldier, and resumed his domestic duties.

And the great horse John Dillard, another foundation sire of the breed of the American Saddle Horse, did similar service between 1861 and 1865, sharing with Gaines's Denmark the honor of leadership and example and comradeship, as he served in camp, on hard marches, and in battle, and when the war was ended resumed his duties in developing the great family of which he was an ancestor. Wallace, as far back as five years ago, accredited twenty horses in the 2.30 list among the Standard (trotting) horses of the country to dams sired by John Dillard.

A visit a year ago to my farm by a representative of a European government for the purpose of getting information in respect of breeding cavalry horses led me to emphasize the unequaled merits of the horse whose four years of service in war had proven him to be the great cavalry horse of the world.

But this horse can not be bought for the very small price which our Government limits, and which limit provides a horse possessing the

governmental requirements as to size and color and soundness, yet our Government prescribes nothing as to movement and breeding and consequent endurance.

Gen. Basil W. Duke, one of the most distinguished cavalry officers of the Civil War, says, in a letter to the Breeder's Gazette, published in December, 1896, the following:

I very cheerfully comply with your request that I shall furnish you an opinion, predicated on actual observation and experience, of the value of the American saddle-bred horse for military and especially cavalry service. I presume you mean to include in this term all horses of the same character—that is to say, a horse produced by a large infusion of Thoroughbred blood into a hardy and serviceable inferior stock, whether bred in Kentucky or elsewhere. Many such horses, bred in Tennessee and other States south of the Ohio, were used by the Confederate cavalry during the late Civil War and largely contributed to its admitted efficiency; but it will not be denied, I believe, that the type had reached then and retains now its highest excellence in Kentucky. This fact is due, I think, to two causes: First, to the wider ramification of Thoroughbred blood in Kentucky, and secondly, to the greater amount of care in breeding—the intelligent experimental method on which all improvement in breeds and strains ultimately depends—which has been systematically practiced in Kentucky. * * *

If I be correct in my estimate of the Thoroughbred, then it must be conceded that the nearer he approximates him, the better another horse will be. But the Kentucky saddle-bred horse has not only inherited in a large measure the excellence of the Thoroughbred in the respects to which I have called attention, but has also retained certain desirable characteristics which have more peculiarly distinguished the humbler strain from which he is descended.

The Thoroughbred horse, while speeedy and in certain ways agile, is not usually so quick on his feet and alert and adroit in his movements as are the best specimens of the inferior breeds which, crossed with him, have produced the saddle horse.

His tremendous stride impairs his activity to some extent. And the reader should dismiss the idea that when "inferior breeds" are mentioned in this connection, any reference is meant to the clumsier and common stocks. The maternal strains of the saddle horse are styled "inferior" chiefly because, as has already been said, they were unpedigreed; and also because they possess in a less degree the qualities which have enabled the Thoroughbred to win on the turf. While not so game and tireless as the Thoroughbred, these strains nevertheless exhibit wonderful endurance under the saddle, and have a cat-like quickness and nimbleness which more than anything else contribute to form the peculiar gaits which make their descendents so valuable for the saddle. * * *

When Morgan marched from Sparta in August, 1862, to surprise a garrison at Gallatin, he accomplished the distance of fully 90 miles, including detours made to conceal his route, in about twenty-five hours. On the Ohio raid, after more than two weeks of very severe previous marching, his command, then about 2,100 strong, marched without halting from Summansville, Ind., to a point 28 miles due east from Cincinnati, a distance which may fairly be estimated at 94 miles. This march was accomplished in about thirty-five hours. Many—indeed, the greater number—of the Kentucky horses which had started on the raid performed this march without flinching; and many of them kept on to Buffington, some even bearing their riders across the Ohio River and returning to the Confederacy. The horses which had been impressed in Indiana and Ohio failed in such an ordeal, never lasting more than a day or two, and often succumbing after a ride of eight or ten hours. * * *

The saddle-bred horse is very valuable for cavalry service, because of other reasons than merely his superior powers of endurance. His smoother action and easier gaits render the march less fatiguing to the rider; he succumbs less readily to privations and exposures, and responds more cheerfully to kind and careful treatment. He acquires more promptly and perfectly the drill and the habits of the camp and march, and his intelligence and courage make him more reliable on the field.

PROPER SIZE FOR THE SADDLE HORSE.

I have felt impelled for the past twelve years to caution my associates who are interested in breeding and developing the American Saddle Horse not to be led into the error of breeding horses too large for the saddle. In the selection and adherence to type, the average height of the American Saddle Horse is approximately 15-2, and the average weight approximately 1,050, and he has endurance, substance, remarkable intelligence, courage, and docility. Under the saddle, in harness—used in either capacity—he equally adapts himself to either service, and the experience of the Civil War demonstrated that no cavalry horse of the armies of the world has ever equaled him in endurance and movement. It is not the large animal of any kind, from the highest to the lowest, that has power to endure most. By no army standard is either the giant or the dwarf, either the large man or the small man, selected to endure hard service. The large ox does not stand hard work so well as the ox of medium size. The large dog, either in the chase or in the field, is not preferred. The large mule can not stand continuous work so well as the mule of average height and weight. The Shire can not live under continuous strains that the smaller horse will easily stand. The Arabian will outlast the Percheron; the great performers of the racing turf and on the trotting turf have been horses of medium size. A very small percentage of the great runners or of the great trotters of the world have been large. All the world over this is true. Of the American horses, I may mention from the Thoroughbreds, Lexington, Grey Eagle, Waggener, Aristides, Kingston, Modesty, Firenzi, Ben Brush, Sir Walter, Mirthful, Ogden, Russell, and nine-tenths of all the great runners, all under 15-2. From the Standard (trotting) horses I mention, Rysdik's Hambletonian, Flora Temple, Goldsmith Maid, Dexter, Ethan Allen, George Wilkes, Nancy Hanks, John R. Gentry, Robert J., Jay-Eye-See, Rythmic, Tommy Britton, Dare Devil, Boreal, Boralma, Directum, Alix, Cresceus, Onward Silver, Pilatus, Alice Barnes, and nine-tenths of all the great horses of the world, all under 15-2.

What is needed is good conformation, good legs, good tempers. The breeders of the American Saddle Horse do not insist on any number of gaits. They care not whether the rider prefers one gait or five. Their wish is to furnish the horse and not to direct at what speed or at which gait he shall be ridden.

The breeders of the American Saddle Horse do not desire to dis-

courage others in their preference for the use of the rough-riding horse, but it is their purpose to continue the development of the horse of unequaled usefulness, having the greater variety of accomplishment and unparalleled beauty, whose versatility is shown by power, endurance, and true gait; by his winning the championships in the hunter classes; by his winning the championships in the plain or three-gaited classes; by his superior qualities as a harness horse; and by his readiness always to be made use of at anything, from going any one or all of five gaits under the saddle to trotting squarely and at a good pace, and often with great speed, to harness. And even the barbarous practice of docking his tail when he is put to some of these uses, eliminating one of his chief ornaments and robbing him of the God-given power of self-defense, does not destroy his matchless beauty and his unequaled grace.

SHEEP RANCHING IN THE WESTERN STATES.

By E. V. Wilcox, Ph. D.,
Of the Office of Experiment Stations.

The extent and importance of the sheep industry in the United States have varied from time to time, in accordance with the price of wool, mutton, and other conditions necessary to the successful and profitable management of sheep. According to the returns of the last census there are at present in the United States about 40,000,000 sheep, exclusive of lambs under one year of age. Montana leads with the largest number of sheep in any one State, and is followed by New Mexico, Wyoming, Ohio, Utah, etc. The number of sheep in nine of the range States of the West which possess the largest numbers of sheep is about 22,000,000, or somewhat more than half of the total in the country.

The management of sheep under range conditions is totally different from that adopted in the Eastern States. In the first place, the natural conditions and environment in the Western States require a different system of management, and the extensive scale upon which the sheep industry is conducted, together with the high price of labor and the comparative inaccessibility of some of the larger sheep ranges, have rendered necessary a system of management which is tolerably uniform throughout the Western range States from Mexico to Canada. While the general system of management of the sheep industry throughout the Western States is quite uniform, certain differences prevail in different States on account of climatic and other conditions, and these will be briefly noted in so far as they are of importance to this discussion.

LAMBING.

In order to give a description of the course of operations connected with sheep raising throughout the year, it is necessary to choose some point in the cycle as a beginning. For this purpose the lambing season may be selected. The proper lambing season is the earliest time of year at which suitable climatic and feeding conditions may be expected. It is not desirable to have the lambs come before the grass starts in the spring, for the reason that without green grass the ewes might not give sufficient milk for the rapid and vigorous development of the lambs. The possibility of cold rains or late snowstorms is a serious consideration in determining this matter. The prevalence of

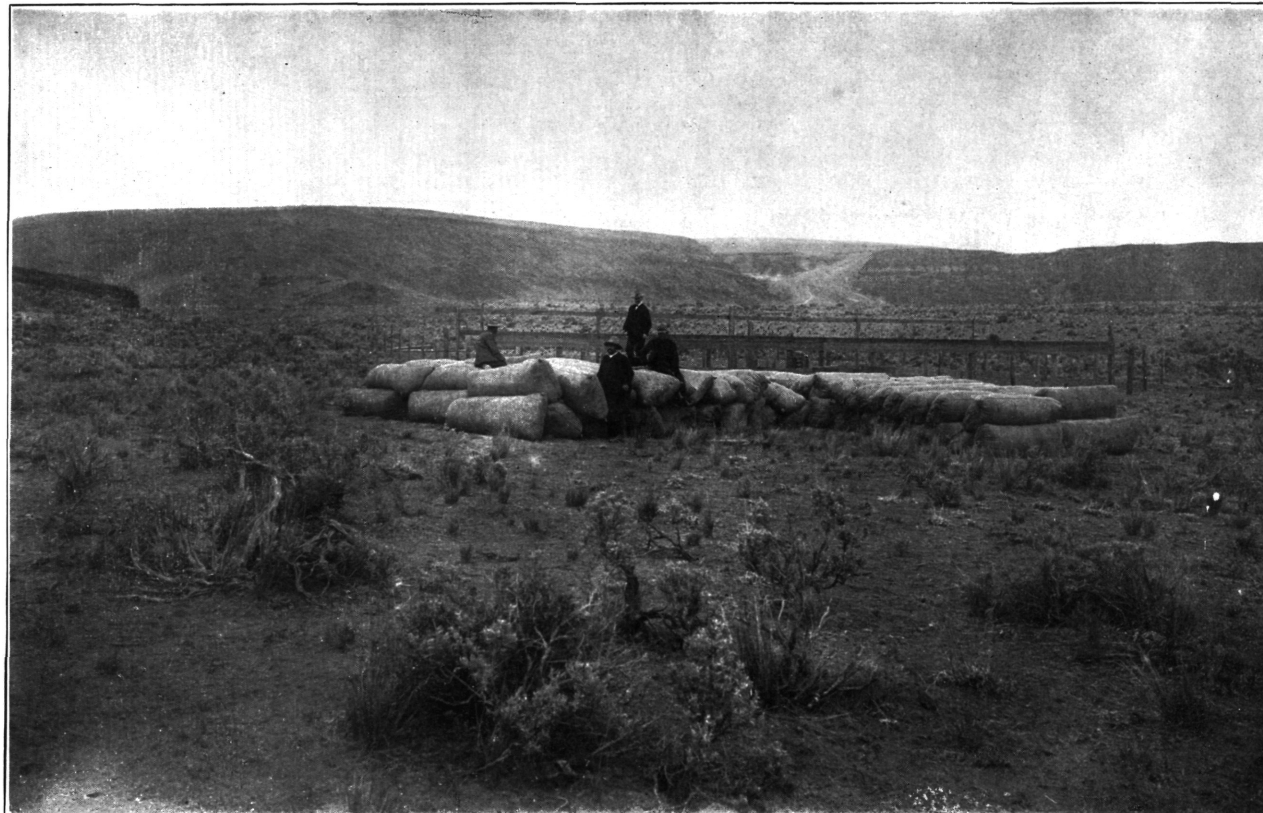
cold windy weather during the first month after the birth of the lambs always causes a more or less serious loss among the lambs. The actual time of year at which the lambs come naturally varies according to the latitude, being much earlier in Texas than in Montana. In the latter State the usual lambing season is the month of May. Some sheep raisers in Montana prefer a slightly earlier lambing season, beginning about the 15th of April. This must depend upon the average climatic conditions of different parts of the State, and as a rule the earlier date is unsafe.

At lambing time a large number of extra men must be hired, since the bands of ewes must be divided into small flocks as soon as the lambs have been dropped. It has been found desirable to put the older, more experienced herders in charge of lambing pens, as many complications may arise which demand some initiative and experience on the part of the herder. The actual details of lambing methods followed in different parts of the country vary greatly, but the methods practiced by certain of the more successful sheep raisers of Montana may be selected as models. As soon as the lambs begin to appear a night herder is placed in charge of the band, in order to prevent lambs which may be born during the night from being trampled to death by other ewes in the corral. The lambs are immediately removed from the corral and placed in individual lambing pens of barely sufficient size to hold the ewe and her lamb. They are kept in these pens for a number of hours until it appears that the lamb is "owned," or "mothered."

During the daytime a lambing wagon constantly follows each lambing band, and the young lambs and their mothers are placed in small apartments on either side of the lambing wagon, where they are kept until the wagon is full, when they are hauled to the lambing shed and placed in individual lambing pens. Ewes with young lambs are maintained for the first few days in small bands of 25 to 100, usually called lambing bands. Each of these bands is under the care of a herder. The reason for keeping the ewes in such small bands is to make sure that the lambs are owned by their mothers. This is an exceedingly important part of sheep raising, and is a matter that requires the careful attention of conscientious herders, for it is well known that if a ewe accidentally becomes separated from her lamb, after 24 hours or more it is very apt to forget the scent of the lamb, and for this and other reasons refuse to own the lamb in the future. All such lambs become "bums," in the usual language of sheep herders, and must be taken to the ranch house and brought up on bottles or allowed to die. The loss of the lambs is not the only unfortunate feature of allowing the lamb and mother to become separated, for a serious condition of the udder may develop in the ewe on account of the unusual amount of milk, and the ewe may thus become permanently incapable of secreting milk. In order to pre-

SHEARING SHEEP WITH MACHINE.

Photograph by Dr. D. Griffiths.



Sacks of Wool.

Photograph by Dr. D. Griffiths.

vent the separation or estrangement of ewes and lambs, the herder has to make sure that the lamb secures milk at reasonably frequent intervals each day for the first week or two. If any tendency is noticed in the ewe to disown the lamb, the ewe is caught and placed again in an individual lambing pen with her lamb.

At the end of the first week or ten days the small lambing bands are gradually brought together until a band of the usual size—about 2,500 to 3,000—is formed. The lambs are now ready for docking, castrating, and marking. These operations are performed at the same time and with great rapidity. The ewe bands with their lambs are driven into a corral, usually in a shed, where they may be easily secured. A number of men (four to eight) are required for manipulating the ewes and securing the lambs for the man who does the docking and castrating. At the hands of expert sheepmen these operations require so little time that 1,000 lambs may be docked, castrated, marked on the shoulder with paint and on the ear to designate sex, within a period of about two and a half to three hours.

The lamb bands are, from this time on, driven to greater distances from the home ranch, but are usually kept within a reasonable driving distance until after shearing time. The distances over which lamb bands travel during the early spring and until the lambs are one month old is considerably less than that traveled by dry bands or lamb bands in the fall.

The percentage of lambs which are raised varies greatly in different years and with different sheepmen. Under extreme conditions it may vary from 50 to nearly 100 per cent. As a rule, however, the extreme losses are due to unfortunate conditions of grazing, while the statement that 100 per cent of lambs have been successfully raised may usually be considered as an exaggeration. As a result of extensive statistics compiled in the United States and England, it appears that about 4 per cent of ewes are barren, for various reasons. The percentage of barrenness is not uniform and may be much higher than the average figures as stated. As a rule, also, from 3 to 5 per cent of the ewes abort, and from 5 to 10 per cent of the lambs die before they are 3 weeks old. Under ordinary circumstances, therefore, 80 per cent of lambs may be considered an average amount of success. This percentage allows for losses from barrenness, abortion, and death of the lambs, and also for the partial compensation of those losses by the birth of twins. Under Western conditions, however, the production of twins is considered a distinct disadvantage and is usually not desired. The reason for this is that where ewes are kept in bands of 2,000 or 3,000 they may manifest no desire to find their two lambs at sufficiently frequent intervals; the presence of one lamb appears to be perfectly satisfactory to the ewe, and the result of this condition is that one or the other of the twins almost invariably

becomes neglected and develops into a "bum." Moreover, in unfavorable years the average ewe appears to be unable to produce sufficient milk for the vigorous development of two lambs, with the result that both of the twins may be stunted.

SHEARING.

The time of year for shearing, like that for lambing, varies according to the climatic and other conditions. It is much earlier in the Southern States, where the sheep are sheared twice a year, and is latest in Montana, where shearing is done during June and until the 20th or sometimes the 25th of July. Shearing in the Western States is a business which is carried on by professional shearers, who travel from one part of the country to another as the season advances. A considerable proportion of these men work during our winter season in the southern hemisphere, especially in Australia and Argentina. In the early spring they begin shearing in Texas and proceed north until the work for the year ends in Montana. On account of the unusual amount of experience which these men have had, they are able to shear with great rapidity. An average of from 90 to 120 sheep is considered a good day's work for a shearer. Very large records have been made by expert shearers. Some of these records are not sufficiently authenticated, but at least 250 sheep have been sheared within a single day by one man.

Within the past five years the establishment of plants for machine shearing has progressed with great rapidity throughout the Western States. At first considerable opposition was raised to machine shearing, both by the sheep owners and by the shearers. The shearers feared that sheep could be sheared much more rapidly by this method, and therefore their business would be interfered with by the establishment of shearing plants. Sheep owners feared that the machine shearing would have a bad effect upon the sheep. It is possible to shear sheep more closely by machine than by hand, and the owners were therefore anxious concerning the effect of snowstorms or the burning sun upon the exposed skin of the sheep. The experience thus far had with machine shearing is satisfactory and favorable to the use of machines. A larger number are being established every year, some owned by companies and others owned by individuals. The motor power, as a rule, is furnished by gasoline engines, and shearing plants are constructed of various sizes, according to requirements, carrying from 10 to 35 or even 40 clippers. The number of sheep which can be sheared by machine is about the same as that by hand shearing. The ordinary shearer averages about 100 sheep per day. The advantages of machine shearing are a neater clip, less cutting of the skin than by hand shearing, and a slightly heavier fleece.

Many sheep raisers who have had extensive experience with both

methods claim that they secure about 1 pound of wool per sheep more by machine shearing than by hand work. With inexperienced shearers the cutting of the skin and injury to the sheep may be considerable by either method of shearing. It is necessary that shearers who have worked only by the hand method should be given some instruction in the use of the machines. For this purpose an expert is usually sent out with each plant and remains to give instruction to the shearers, and to see that the plant is in working order. The process of shearing occupies considerable time under the most favorable conditions, and it is therefore desirable to proceed with as great rapidity as possible. As a rule, each shearer, whether working by hand or with a machine, stands in front of a pen, which holds about ten sheep. The pen is made of sections of fence and is surrounded merely on three sides, the sheep being prevented from running out in front by the presence of the herder. The sheep are sheared, whether by hand or by machine, on a level floor, the shearer standing at the same level with the sheep. The animals are never tied or restrained in any way except by the left hand and the legs of the operator. As soon as a sheep is sheared, the fleece is kicked out of the way by the shearer, the animal is released into the pen and another one is grasped. When all the animals in the pen are sheared they are let out and the pen is immediately refilled by other sheep, which are manipulated by men employed for that purpose. The length of time required for shearing a single sheep is about four or five minutes. As soon as the fleece is removed it is tied up by a man whose only task is to tie up and remove the fleeces. A small truck running on a tramway in front of the whole line of shearers serves to carry away the tied fleeces to the end of the shearing shed, where the wool is trampled into large sacks. For the purpose of sacking the wool a scaffold is built with a circular opening at the top so constructed as to receive the hoop of the woolsack. The sack is firmly attached to the hoop and the sacker springs into the sack. The wool is then thrown into the sack and firmly trampled down until the sack is filled as full as possible. It then contains from 300 to 400 pounds, and is tied up ready for hauling away to market.

On account of the great distances from the railroad, the hauling sometimes requires so much time and so many horses that a special trade in wool freighting has been developed by men who possess wagons and horses suitable for this purpose. In freighting wool long distances by horses, economy demands that very large loads should be hauled. It is therefore not an infrequent sight to see wool-freighting teams of ten to twenty-four horses moving across the plains to the nearest wool market.

No sorting of the wool is done on the ranch, with the exception of the sacking of the wool of black sheep separately. Black wool brings a much larger price than ordinary wool, but when mixed with other

wool has to be sold for the ordinary price. On large ranches, where there are from 20 to 100 black sheep, enough black wool may be secured to fill one or more sacks, and may thus be sold for its higher market price.

The desirability of exercising care in cleaning hand shears or the clippers attached to the machinery of shearing plants has been shown on many occasions. It frequently happens that malignant edema develops to a more or less serious extent as the result of the careless cutting of the skin during shearing. Where large numbers of cases develop in a single shearing shed the place may thus become permanently infected. It is then necessary either to abandon the plant and establish another one in a new location, or thoroughly to disinfect the soil in the corral and pens and to disinfect the woodwork with which the sheep may come in contact. Malignant edema sometimes develops to an alarming extent within a few days after shearing, and in most cases the disease can be traced to infected soil where the sheep have lain down after being sheared or to the uncleanliness of shears. It would be a comparatively easy matter to dip all shears frequently in an antiseptic solution, such as formalin. The danger of spreading malignant edema by the careless cutting of the skin would thus be largely eliminated. When these precautions are taken, little harm seems to result from the ordinary cuts which sheep receive in shearing. Where, however, the cuts are of considerable extent, it is desirable to treat the skin with an antiseptic solution or to take a few stitches in the cut.

DIVISION OF THE RANGE ACCORDING TO SEASONS.

As a rule, sheep ranches are so located that the range which each man controls may be readily divided into a summer and winter range. Naturally the summer range is located at higher altitudes than the winter range or in locations where a comparatively large amount of rainfall occurs. In general, summer ranges are located on the mountains, where large tracts of high plateaus and the mountain meadows of various sizes furnish succulent forage during the months when the winter range would be too dry. The necessity of summer range for the management of sheep is in all cases very great and in many localities is absolute. The ewes require green forage during the months of June, July, and August, in order that the milk supply may be maintained at a maximum. As soon as the lambs begin to eat grass, which usually occurs at one to two months of age, they require green forage even more imperatively than the ewes. In most localities where sheep are raised on a large scale these conditions are found only in the mountains. A considerable proportion of the best grazing ground for summer use is found in forest reserves, and this explains the great anxiety of sheep men in securing the privileges for grazing during the summer in forest reserves.

The time of the year at which sheep are driven to the summer range varies greatly according to latitude and climate. In New Mexico and Arizona the sheep may be taken to the summer range in April, while in Montana, Wyoming, and other northern mountainous districts sheepmen may not attempt to enter the mountains with their bands of sheep until June or July. On the northern ranges, therefore, the sheep are not taken to summer range until after shearing, while on the southern ranges this may not be the case.

It is not the purpose of the present account to discuss in detail the bitter controversies which have arisen concerning the use of public grazing lands by sheep men, especially in the forest reserves. It will, perhaps, suffice to state briefly a few of the complications which arise from the present system of managing sheep during the summer. Sheep men maintain that the privilege of entering mountain pastures, whether in forest reserves or elsewhere, is absolutely necessary for the successful conduct of the sheep business. Cattle men, on the other hand, claim the same privilege and assert the same necessity. It is furthermore maintained by the cattle men that the presence of sheep on a given range renders impossible the grazing of cattle upon that range. It is therefore asserted that the sheep men thus have a distinct advantage over the cattle men in that the former can drive the cattle off the range by the mere presence of sheep. As already stated, no attempt can be made in the present article to pass judgment upon the merits of the two contending parties. It is apparent, however, that exceedingly unpleasant complications may arise from these conditions, and the long list of shooting affairs which occurs from year to year is sufficient evidence of the bitterness which prevails in this controversy.

Without passing judgment upon the conditions surrounding any forest reserve or other mountain grazing areas, it may be justly asserted that the sheep and cattle business can be conducted in the same locality on a peaceful basis and with profit to all parties concerned provided there is a mutual recognition of the rights of all parties. The mere presence of sheep upon a mountain meadow does not involve the destruction of the grass or timber, provided the sheep are maintained in a rational manner. That sheep grazing, however, may result in the total destruction of the range and great injury to young trees has been abundantly demonstrated in many forest reserves.

In regard to the management of sheep, whether on summer or winter range, it may be affirmed as a general proposition that the less the sheep are interfered with the less injury they will do to the range. When sheep are maintained in bands of from 2,000 to 3,000 it is necessary, for several reasons, that they should be allowed to feed in a comparatively open formation. One frequently notices the continual worrying and harassing of the sheep by young and inexperienced herders, who seem to feel that some of the sheep may be lost if the

band is not kept huddled together. The great disadvantages of keeping a large band of sheep close together should be sufficiently apparent upon a moment's thought. In the first place the injury to the grass and young trees is far greater when the bands are not allowed to spread out. The grass is trampled down, the roots injured, and the ground dug up so that erosion is much more rapid and disastrous. Then, too, the sheep have much greater difficulty in feeding. The only animals in the band which can feed with ease are those which happen to be on the outside. Those in the center of the band are crowded together by the continual pressure and are more or less effectively prevented from grazing. The result of this form of management is that the sheep have to travel much farther each day than they normally would if allowed to scatter to a reasonable distance and to feed without unnecessary interference.

The better class of sheep ranchers are men who own plants of considerable value, are definitely located, and fully recognize the great importance of preserving the summer range in as good condition as possible. They therefore give orders that the sheep should not be maintained for too long a period in any one camp, and that the camp movers or herders should move the bands of sheep to new camping grounds before any serious damage has been done to the grazing of a given locality. The range is thus preserved in a condition to produce a fair yield of grass from year to year.

Where, however, tramp sheep compete with those of local sheep men for possession of the summer range, great and even irreparable damage is done to the grass. Perhaps the chief cause of the unpleasant feelings between cattle men and sheep men, and certainly one of the chief causes of the frequent acts of violence on the summer range, is the presence of tramp sheep. Throughout the range States hundreds of thousands of sheep are owned and maintained by men who either have no permanent home or at least have no sheep ranch. These men employ herders who are instructed to move their sheep from place to place wherever they may secure grazing. Naturally the tramp sheep are maintained during the winter in the southern range country, where the climate is mild. As soon as the dry summer months appear the sheep are driven northward to Wyoming or Idaho or even farther north; the whole circuit covered by a single band of sheep during the year may be very extensive. Naturally no agreement is reached between the different tramp sheep men as to the localities which they will visit during a given season. It may therefore result that excessive numbers of sheep attempt to find grazing ground in one part of the mountains, and that the grass may be grazed off so short as to be almost destroyed for a number of years and the sheep may even then be unable to secure enough forage to prevent great loss in weight. This excessive grazing in certain localities from year to year not only causes unnecessary strife and violence between differ-

ent tramp sheep men, but also causes great inconvenience and loss to local sheep men, and particularly to cattle men. So long as the public range is considered to be anybody's property, and may be had by simply exercising a sufficient amount of violence, these conflicts will continue, together with the destruction of the range and the inconveniencing of local, responsible stock raisers.

The method of managing sheep on the summer ranges varies greatly in different parts of the country and with different sheep men. In some localities which are readily accessible, large and commodious sheep wagons follow the bands of sheep from place to place, and in these wagons the herders carry their necessary utensils, food, clothing, and beds. The usual form of sheep wagon contains a cook stove, convenient arrangement for sleeping, and a supply of food and medicines. These wagons may be hauled by two or four horses, according to the condition of the roads. In more inaccessible places one wagon may be required to furnish service for a number of herders who sleep in tents near the night camping ground for the sheep. Under such conditions each herder establishes a camp at some location protected from storms and conveniently near water, fuel, and grass. The sheep are driven each day a distance varying from 1 to 3 miles, and at night they are brought back to camp. As soon as the grazing becomes short in that locality the camp is moved some distance and the sheep are maintained about the new camp as a center for a similar length of time. The camp moving and the new location of the band of sheep are usually determined upon by the camp tender, who, as a rule, maintains his camp together with that of the herder, who is in charge of the most accessible band of sheep. In mountain districts which are inaccessible by wagon, sheep are managed in the summer by mounted herders who carry their food and bedding upon pack horses. During the day all the horses may be picketed in the neighborhood of the camp while the herder follows the sheep on foot. Herders are always assisted by sheep dogs. These dogs are a prime necessity in managing sheep under range conditions, and are particularly useful on summer range where sheep are subject to attack at night by coyotes, mountain lions, or bears. The presence of a dog under such conditions may prevent fatal stampeding of the band and consequent heavy losses.

FORAGE PLANTS FOR SHEEP.

The feeding habits of sheep differ much under different conditions. Usually the grasses on summer ranges are comparatively high, and a large proportion of the forage plants, other than grasses, is found mingled together with the grasses. Sheep eat a great variety of plants, according to circumstances, and the variations in their feeding habits are so marked as almost to preclude any general statement of their preferences under any given conditions. In fact the varia-

tions in the feeding habits of sheep of a single band may be exceedingly great. Some sheep, upon summer range, appear to prefer grasses to all other plants. The choice of grasses, however, by different sheep is by no means the same. In some of the ranges in the mountains buffalo grass prevails; in others, bunch grass and various species of blue-joint predominate. There are scarcely any native plants in the mountains which are not eaten to some extent by sheep. All plants except grasses are usually classified in one group by herders under the term "weeds." These plants furnish a considerable part of the summer forage of sheep. Chief among such plants are the native legumes (including wild licorice, false lupines, and some of the species of Astragalus, Aragallus, and Lupines), geraniums, five-finger, Spiræa, etc. Various other plants are eaten from time to time, and some of these in certain stages of growth may be more or less poisonous. As a rule, it has been found that the danger of poisoning by plants is greatest in the early part of the season, yet many thousand sheep are killed from lupine poisoning in the mountains nearly every fall. Sheep men therefore delay driving the sheep into the mountains until the time of greatest danger, as shown by experience, is past. In Montana and Wyoming it has been found to be comparatively safe to enter the mountain meadows with sheep about the 1st of July.

WATER.

The problem of securing water for sheep is always an important one. The frequency with which sheep must be watered differs according to the system of management and according to the nature of the forage plants. In parts of Arizona and New Mexico where, during the hot dry summer months sheep graze upon succulent plants, they may be maintained upon the range for a period of sixty days without water. The other extreme of frequency in watering may be observed in parts of Montana, where some sheep owners water their sheep three times per day. In general no artificial arrangements are made for convenience in securing water. Sheep are simply driven to ponds or pools (sometimes alkali pools) or to mountain streams. Some sheep men, however, have found it profitable to pipe the water from springs into troughs, where sheep may obtain it much more conveniently.

SALT.

Great differences are apparent in the practice of different sheepmen with regard to the use of salt. Some men regularly furnish salt for the sheep, so that it is accessible at all times. The salt is usually supplied in the form of rock salt, which can be licked by the animals. On the other hand, many sheepmen never supply salt to their sheep, and maintain that they have better results from allowing the sheep to find alkali licks than from supplying them salt. Many sheep men

Sheep on Range in Open Formation.

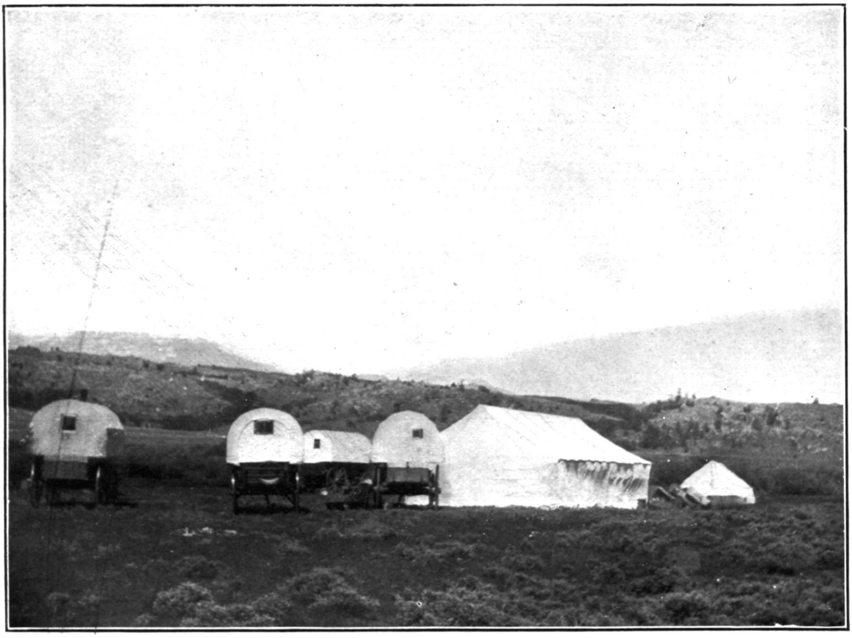


Fig. 1.—Sheep Wagons.

Fig. 2.—Herder's Camp.

MOUNTED HERDER.

Photograph by Dr. D. Griffiths.

SHEEP ON WINTER RANGE.

think that perhaps the development of the so-called loco disease may be in some way connected with eating alkali or drinking alkali water, and it has been maintained by some of these men that the extent of the loco disease among their sheep diminished greatly after adopting the practice of salting their sheep regularly and thus preventing them from eating alkali. The nature of the alkali, however, must largely determine this matter. In some parts of the Western range country, where the alkali, according to chemical analyses, contains as high as 85 per cent of common salt, it must be considered as an ample substitute for artificial salt. Where, however, the alkali is composed largely of corbonate of soda, sulphate of soda, or Epsom salts, it can not be assumed that those substances can replace common salt in the physiological activities of the animal. The great differences in results which have been noted from allowing sheep to eat alkali in different localities may well be due to differences in the nature of the alkali. Except in localities where the alkali is largely common salt, it is undoubtedly better and more profitable to salt the sheep regularly.

WINTER RANGE.

The sheep are kept upon the summer range as long as the weather permits. Where sheep are maintained at tolerably high altitudes in mountain pastures it is necessary to move out of the mountains at a sufficiently early date to avoid danger of blockade in the early fall snowstorm. The limit of the safe period in this regard has been learned by experience in the various localities where the sheep industry is conducted. The time of year will naturally vary in different parts of the country, but usually sheep men prefer to drive the sheep out of the mountains before any signs of deep snows appear rather than take chances of suffering the severe losses which are occasioned by snowstorms. In the sheep-grazing portions of Montana the period at which the sheep are driven down out of the mountain ranges from September 15 to October 1. The location of a winter range is naturally chosen for its convenient proximity to the ranch house or to large sheds or haystacks. In localities where deep snows may be expected in winter the sheep must be maintained, of course, near covered corrals or a supply of hay in order to prevent disaster which might arise from becoming surrounded by snow. Throughout a large portion of the range country; however, the winter range is very favorably located with regard to the amount of snowfall. Even in the northern parts of Montana, where the temperature may reach a low point, the fall of snow upon the level plains is ordinarily very slight. Generally, sheep are able to maintain themselves in fairly good condition throughout the winter without being supplied with any hay or, at most, by a short period of feeding in case of a fall of wet snow which subsequently becomes incrusted. The high winds,

which prevail upon the level plains in winter are instrumental in driving into ravines the small quantity of snow which falls and in keeping the greater portion of the range bare throughout the winter months.

In moist climates grass which is allowed to stand over upon the ground until winter is valueless. In the mountainous countries, however, with dry atmosphere, the grass appears to cure about as successfully if allowed to stand as if harvested and stacked. The result of these favorable conditions is that so long as the grass is not covered too deeply with snow sheep are able to keep themselves in good condition and do not really require any other food, unless it is desirous to maintain them in a particularly fat condition.

In order that sheep may be able to thrive well upon winter range without supplemental feeding, it is necessary that these ranges be protected during summer and that no animals be allowed to graze upon them; otherwise grass would be too short for successful grazing in winter. The sheep men, therefore, reserve a certain portion of the range at their disposal strictly for winter use and, as already indicated, seek grazing ground for summer in forest reserves or other mountain pastures. It is a fact of considerable importance with regard to the winter ranges that these tracts are covered more exclusively with grass than are the summer ranges. Weeds and other plants than grass grow much more abundantly and luxuriantly in the moister soils of the mountains than upon the plains. These plants, however, are of little value for grazing purposes in the winter, with the exception of a few especially succulent or hardy species. Among the plants other than grasses which are of value upon the winter range special mention should be made of legumes, particularly lupines and the various species of sagebrush. Sagebrush is seldom eaten by sheep during the summer, but in winter it serves to furnish a large amount of forage of considerable value. A number of species have been recognized by sheep men as of special importance and are commonly referred to as sweet sage, sour sage, white sage, etc. Lupines retain a certain portion of their leaves, and the stems also appear to be of considerable feeding value. These plants, together with the dry empty pods, are apparently relished by the sheep during the winter months.

It is not necessary to have a running water supply for sheep in winter, provided snow can be found. Sheep men may therefore in winter utilize range country upon which no running water is ever found. The sheep simply eat a quantity of snow each day, and when the snow is melted in the spring it becomes necessary to move the sheep to other range in order to secure water. The necessary water for camp purposes under such conditions is, of course, obtained by melting snow in the camp kettle.

BREEDS.

In former years a decided tendency was manifested among sheep raisers to keep only pure, or nearly pure, breeds of sheep, either fine-wool or coarse-wool, according to the product which the raiser wished to secure. Frequently, however, by taking one year with another, it has become apparent that more profit is to be obtained from raising a general-purpose sheep than by attempting to produce a wool sheep or a mutton sheep. It has therefore been found desirable to produce a cross, combining so far as possible a good mutton form and a large production of wool. In order to perpetuate the proper cross in the majority of stock sheep, it is necessary to maintain two flocks of bucks—one of Merino breed and the other of Cotswold or Lincoln. The two last-named breeds are generally preferred in Northwestern range country for crossing upon ewes with too fine wool. Naturally, as soon as the lambs show a tendency to produce too coarse wool they are in turn crossed with some race of Merino, usually Rambouillet, Delaine, etc., in order to turn the tendency of the herd in the opposite direction. It thus appears that by the judicious use of fine-wool and coarse-wool bucks a supply of stock sheep may be kept on hand which are graded so as to combine mutton and wool producing qualities in a satisfactory manner. The hardiness and fecundity of these grades is not less than those of purebred sheep under the same conditions. The admirers of various pure breeds make claims with regard to the superior ability of their particular breed to secure forage and maintain itself in good form under adverse conditions upon the range. Different sheep men, however, have had different experiences in comparing the relative values of different breeds of sheep; and the majority of sheep raisers, especially in the Northwestern range country, are at present agreed that a crossbred general-purpose sheep, such as already described, is the most successful and most profitable animal to raise.

WEANING LAMBS.

The process of weaning lambs varies with different sheep raisers and under different conditions. In cases where ewe bands are maintained in forest reserves or other mountain pastures during the summer, lambs are not separated from their ewes until the return of the sheep in the fall to the winter range. The age at which lambs are weaned varies from three to six months. The process will therefore naturally vary somewhat according to the age of the lambs. If lambs are allowed to run with the ewes from five to six months, the ewes will be nearly dry by the end of that period and will require little or no attention when the lambs are separated from them. The only precaution necessary in this connection consists in removing the lambs to some distance so that the ewes and lambs will not hear one another's calls. If the lambs are separated from the ewes within a

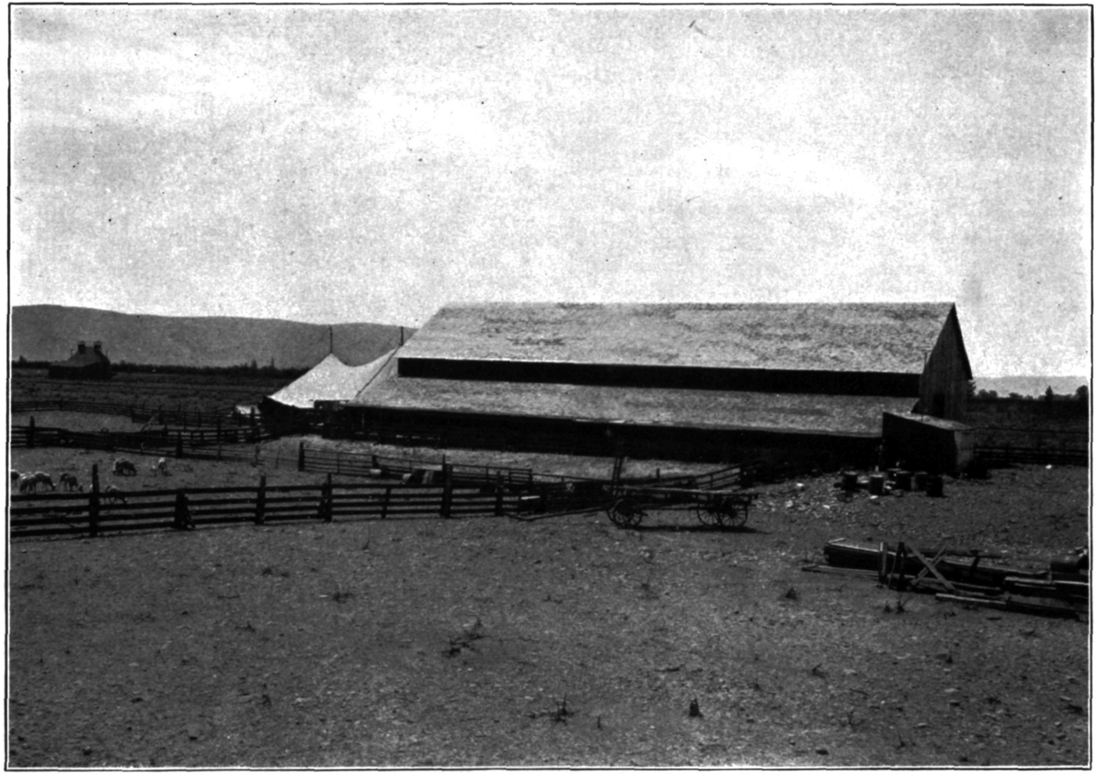
period of three months after birth, some attention will be necessary in order to prevent inflammation of the udders of the ewes for the first few days. This may be prevented by milking. Under range conditions, however, the great amount of time involved in this process renders it necessary to plan the time of weaning so that no such complications will arise after the lambs have been separated from the ewes. It frequently happens that old ewes and their lambs are prepared for market at the same time. Where this is the case they are maintained on extra fine range during the summer months and are sold together early in the fall. In such cases the lambs are not weaned.

BUCKS.

The bucks are maintained in separate bands of varying sizes, depending upon the number of sheep which a stock raiser owns—from 50 to several hundred. They are herded in these small bands upon the range by a special herder, and shortly before the bucking season and during that time usually receive additional rations of grain. In Montana and Wyoming the bucks are turned in with the ewes about December 1, and remain with them for about one month. As the period of gestation in sheep is about twenty-two weeks, or five months, this makes the lambing season fall during the month of May, which has been found to be the most desirable month for lambing in Montana and the greater part of Wyoming. In the Pacific coast States and in the Southwestern range country these periods vary according to the climate and other conditions. The number of bucks which are required for the production of vigorous lambs varies somewhat in the opinion of different sheep raisers, but, as a rule, 1 buck is furnished for each 50 ewes.

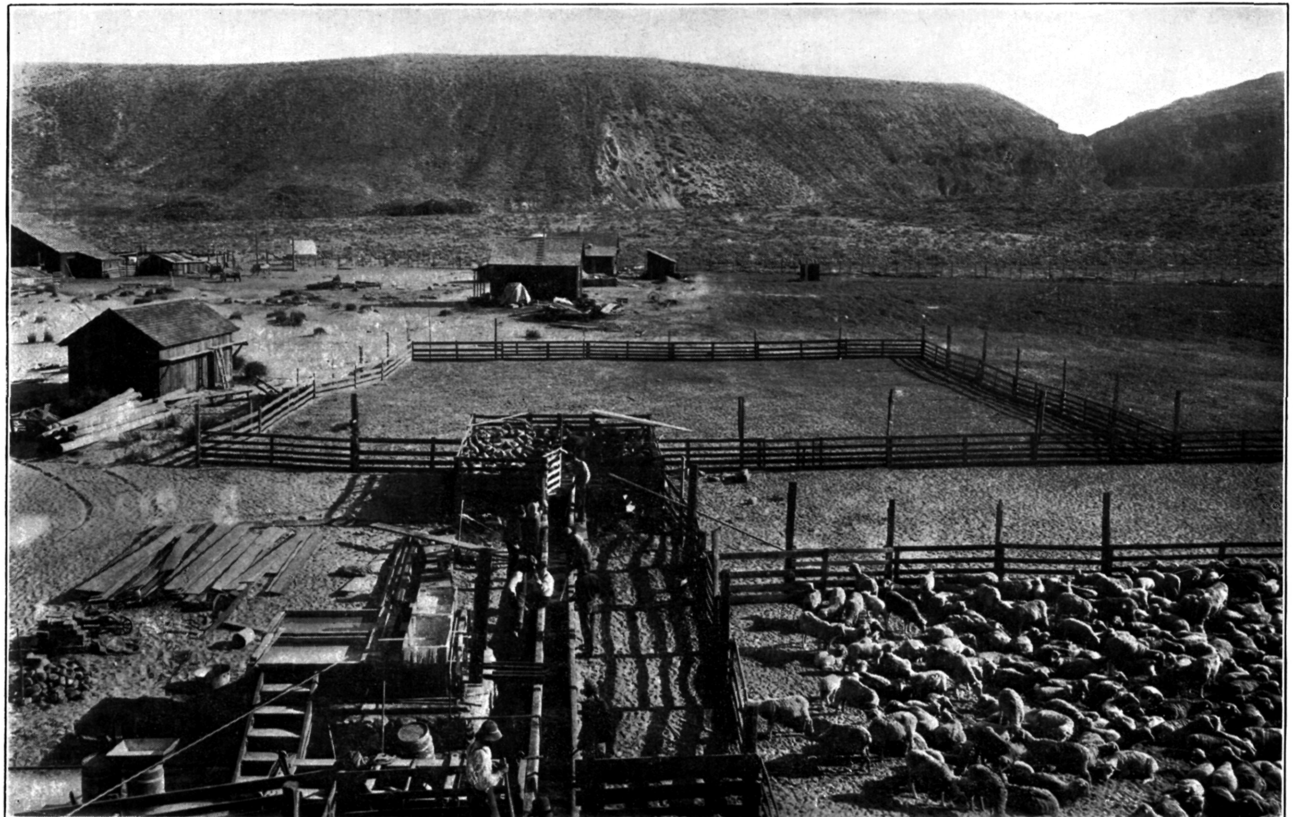
BUILDINGS.

In the early days of sheep ranging in the Western States little attention was paid to the matter of buildings or corrals. It was found absolutely necessary to construct crude corrals out of poles or brush, but frequently no attempt whatever was made to provide protection for the sheep from inclement weather. Experience has shown, however, that while it is possible to do without buildings to a large extent, increased profits are secured when proper attention is given to this subject. The result of this has been that at present the buildings and corrals of a prosperous and progressive sheep raiser are extensive and costly. In the first place, extensive lambing sheds are necessary for use during the lambing season in the spring. These, as already indicated, contain large numbers of individual lambing pens, and also larger inclosed spaces in which ewes with young lambs may be kept for a few days at a time during severe cold storms. These sheds are frequently built in very large proportions—for example, 50 to 75 feet



Sheep Sheds and Corrals.

Photograph by Dr. D. Griffiths.



Dipping Plant.

Photograph by Dr. D. Griffiths.

wide and 175 to 200 feet long. They are usually constructed of rough lumber, and the cracks between the boards are covered with narrow strips. Perhaps the best and most extensively used material for roofing is sheet iron, which requires painting about every other year in oder to prevent it from rusting. Recently many sheds have been constructed in which the whole exterior is covered with sheet iron. A shearing plant is almost a necessity for every large sheep ranch. This consists of extensive corrals for handling the sheep at shearing time, a covered shed of liberal dimensions for storing the wool before it is ready to market, and the actual shearing shed in which the machinery for shearing is installed, or in which booths are arranged for convenient hand shearing. Additional structures are necessarily connected with the shearing shed, such as the platform for holding the woolsack and the engine house for the protection of the gasoline engine.

The corrals which are to be seen on large sheep ranches differ according to the purposes for which they are used. A large number of cheap corrals, usually without cover, are located at various points throughout the grazing ground at the disposal of each sheep man. Each band of sheep is driven back at night to one of these corrals and remains in the corral until daylight next morning, when it is let out for feeding again. These corrals simply serve the purpose of preventing the sheep from becoming scattered during the night, and furnish some protection against the attacks of coyotes. Feeding corrals are usually more securely built, and are located near the ranch house, where the sheep are maintained during the winter season. One of the most extensively used materials for constructing these corrals is fence panels. These readily permit the construction of a corral in any desired shape, and may be held together by wires and posts set at regular intervals. An opening may therefore be made in the corral at any desired point at a moment's notice. These corrals are either built so that the sheep have long straight runways, interrupted by spaces into which teams can be driven for the purpose of hauling hay, or the sections of fence are set in a zigzag manner, so that the sheep do not have a runway of great length. They are thus prevented from racing about the corrals too much. This has been found desirable in some instances, especially with young lambs, since they may render the fattening process too slow by their excessively vigorous exercise.

Corrals for winter feeding of sheep are usually connected with open sheds in which the sheep may seek protection against snow and rainstorms. These sheds may be furnished merely with a roof, or may be walled in on all except one side. The requirements for such structures naturally vary according to the climatic conditions of the winter season. The cost of constructing sheds is in most instances more than counterbalanced by the saving of feed during the fattening period.

WINTER FEEDING.

As already indicated, little or no attention was paid to winter feeding during the early days of sheep ranching. Sheep raisers soon found that many localities could be selected where the fall of snow in winter was exceedingly light, and where, therefore, the sheep could reasonably be expected to maintain themselves safely during the winter. Whenever exceptionally heavy snows occurred, however, large losses were suffered, and these losses were especially severe in late spring snowstorms, when the sheep were already somewhat weakened by the trying climate of winter. At such times it frequently happens that a wet snow is immediately followed by freezing weather, so that a stiff crust is formed upon the snow. The sheep are thus practically prevented from securing grass, and, where no provision is made for feeding, large losses must be suffered.

As more and more persons engaged in the industry of sheep raising, and as the valuable range was more nearly taken up for this purpose, it was found desirable to produce enough hay in connection with the ranch to provide for emergencies of the kind just mentioned. The winter forage which is used in the ordinary sheep ranch is not the same in different parts of the country. Some men raise alfalfa, clover, timothy, and brome grass for feeding sheep. Alfalfa is the chief crop raised for this purpose and is by all odds the most valuable for Western range conditions. These crops, however, can not be raised, except on land where water can be obtained for irrigation. Under such conditions alfalfa can be produced very cheaply. In some parts of Montana sheep men have found that alfalfa can be produced, harvested, and stacked at 75 cents to $1.25 per ton. Practical feeding experiments carried on by sheep men on a large scale show that good alfalfa hay is worth from $5 to $7 per ton for sheep feeding. The great profit possible from raising alfalfa is thus sufficiently apparent. Some sheep ranchers raise from 100 to 1,500 acres of alfalfa yearly and feed it during the winter. This involves the maintaining of a hay gang from June until October, for three crops of alfalfa may be cut annually in Montana and a correspondingly larger number in the Southern and Pacific range States, so that as soon as the ground is cut over once it is necessary to begin again for a second crop.

Many sheep men, however, are not so favorably located or have not learned the value of cultivated forage crops. These men cut native grasses and other plants for winter feeding. In some parts of the range country wild blue-joint can be obtained to the extent of about 1 ton per acre on land upon which no work has been done. Even a larger amount of hay, made up of mixed grasses, may be obtained on marshy land, and this hay has proved in practical experience to be an exceedingly valuable feed for sheep as well as for other animals. In certain localities large quantities of plants other than grasses are cut for winter forage. Perhaps one of the most important plants in Mon-

tana and parts of Wyoming is lupine. A number of species of lupine grow to a height of from 2 to 3 feet and cover the ground continuously in large areas, sometimes whole square miles being almost exclusively occupied by some species of lupine. These plants are easily harvested, requiring about the same attention as alfalfa in curing. The lupine hay is stacked and is fed in the same manner as other hay. While the stems of these plants may be exceedingly coarse, they are eaten as cleanly as alfalfa or other cultivated hays. In some instances serious losses of sheep have been experienced from eating lupines, but these losses have not deterred sheep men from using the plant, since they have found it to be safe under ordinary circumstances. It appears that lupines are most poisonous when they contain ripe seed, and it is therefore desirable that lupine hay should be made late in the season after the ripe seeds have fallen off. This period for Montana will fall in ordinary years during the latter part of August and first part of September.

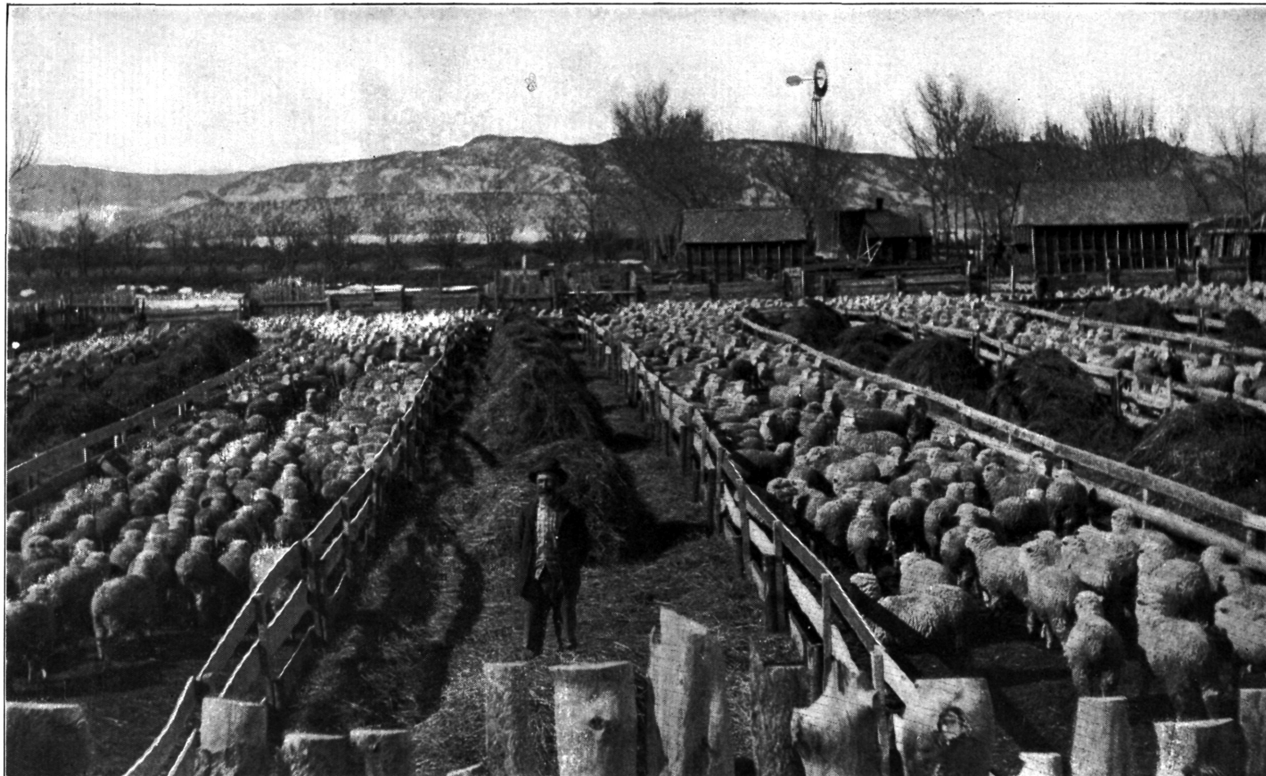
Sheep which are not intended for market, but merely for stock purposes, are naturally not forced during the winter, but are fed merely enough to keep them in fairly good condition. In order to produce this result it has been found sufficient to protect the winter range so as to leave good grass upon it for winter grazing and to feed hay at all times when the grass happens to be buried in snow. For feeding lambs in the early winter some attention must be given to market requirements, and a different method of procedure is adopted from that which is practiced with stock sheep. In feeding for the market young lambs or old sheep are placed in feeding corrals and are usually not allowed to run upon the range, but where they are given too much freedom the cost of fattening is proportionately greater. The hay which is used as a coarse feed is most conveniently fed on the ground without the use of feeding racks. In the first place, feeding racks are expensive and experience has shown that, even with the best of them, more hay is wasted than in cases where the hay is fed directly upon the ground. The most effective, convenient, and economic arrangement for feeding sheep has been found in a corral constructed of sections of board fence in a zigzag manner and so arranged that the hay can be scattered along one side of the fence while the sheep are on the other side. The fence should be boarded tight up to the height of the sheep's neck; a space should then be left of proper size for the sheep's head. It is thus apparent that the sheep can not trample upon the hay. Experience has shown that no hay is pulled through the fence by the sheep while feeding. As a rule, the space is all occupied and the sheep do not show any tendency to back out of the place and thus pull hay with them. These feeding corrals should be built so as to include a small section of a running stream, or, still better, should have a low trough of running water to which the sheep have constant access. Salt should be supplied them in

large chunks, and roots and grain may be fed in special troughs according to the desire of the feeder. In extensive experiments carried on at Bigtimber, Mont., by a practical feeder, it was found possible to put lambs in excellent market condition by three months' feeding on alfalfa hay, together with a small quantity of roots, and without any grain. Grain may be judiciously fed, however, in case it can be obtained at a reasonable price, or is grown upon the ranch. It may be stated that sheep ranchers seldom feed grain to any except the buck bands. The feeding of grain is largely reserved for sheep feeders, who buy range sheep for the special purpose of feeding them for the market.

COSTS AND PROFITS OF SHEEP RANCHING.

The cost of managing sheep under range conditions necessarily varies within rather wide limits. If the sheep raiser simply makes use of public lands without paying rental and taxes, and if he is fortunate enough to find suitable grazing in localities where winter feeding is not necessary, the sheep business may be conducted at a cost of about 25 cents per head per year. On the other hand, sheep raisers who maintain extensive plants, feed in winter, and rent or own a considerable portion of the land upon which the sheep graze have found that the cost of managing sheep under these conditions varies from 75 cents to $1.25 per head per year. This estimate of the expenses includes all items of expense connected with the management of sheep under range conditions, such as horses and other animals necessary for driving and draft purposes, household expenses, etc., as well as actual management of the sheep.

The income from sheep managed under range conditions varies according to the locality and the skill and intelligence of the sheep owner. In localities where the wool is comparatively free from sand and where the fleece is of average weight, the income from the fleece of each sheep at present prices is from $1 to $1.50. The lambs may be sold in the fall at $2 to $3, depending upon their condition. By a comparatively short period of feeding considerable weight may be added to the lambs, and additional profit may be secured in this way. When the number of lambs raised to maturity is 80 per cent or above, the profits from the sheep industry, when properly managed, can be made as great as from any other legitimate business. Some of the more progressive sheep owners make a profit of as much as $1.50 per head for all sheep maintained on the ranch. Such high profits can not be obtained every year, and such an amount is certainly higher than the average. Serious misfortunes may occur, such as extensive losses from poisoning, stampeding by coyotes, etc., and these losses may greatly reduce or almost annihilate the profits for the year. The business of sheep raising under present range conditions, however, is considered exceedingly profitable, and perhaps one of the best proofs of this fact is to be found in the great increase in the number of sheep



FEEDING CORRAL, WITH STRAIGHT FENCE.

Feeding Corral, with Zigzag Fence.

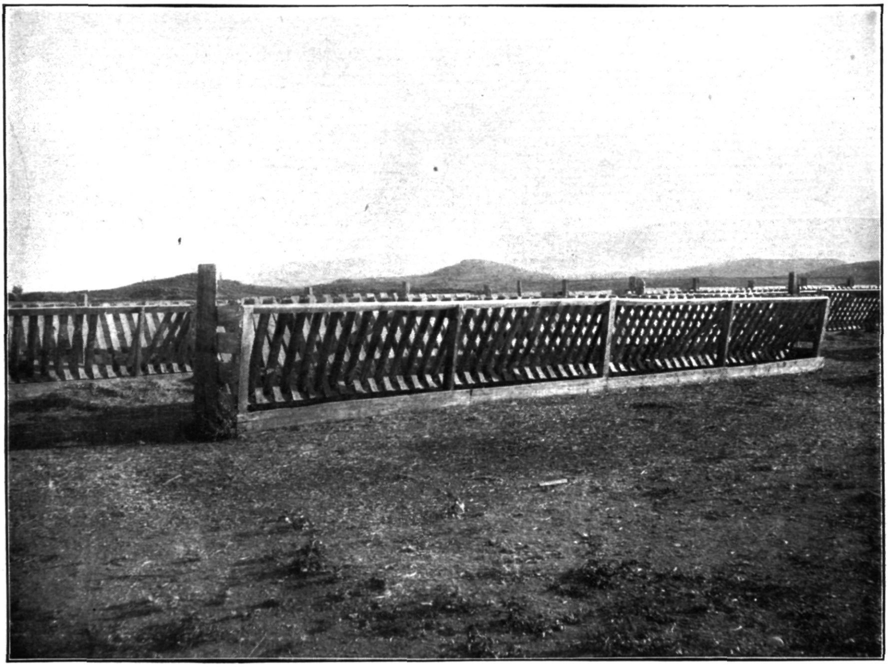


FIG. 1.—LATTICE RACK FOR FEEDING ALFALFA TO SHEEP.

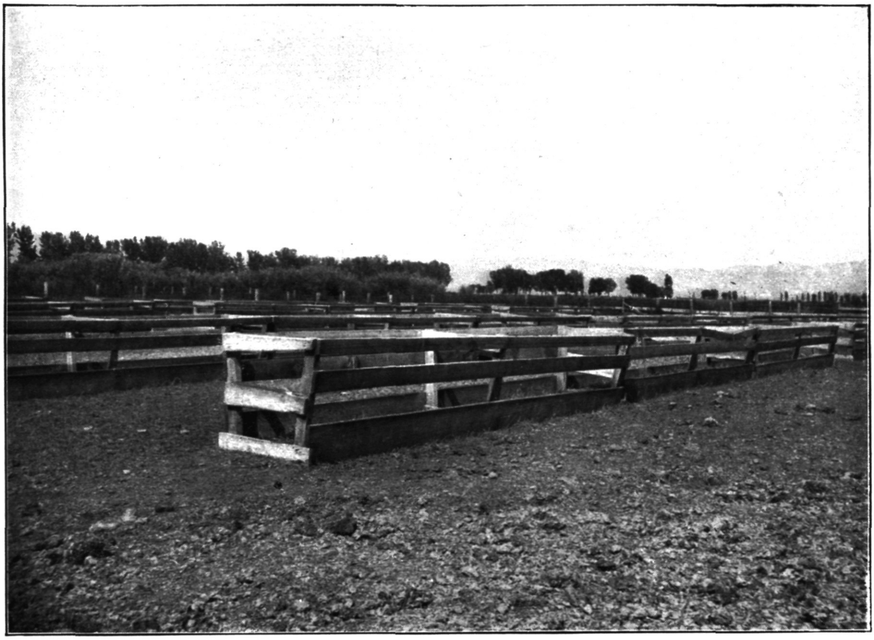


FIG. 2.—BOX RACK FOR FEEDING ALFALFA TO SHEEP.

From Bulletin No. 31, Bureau of Plant Industry.

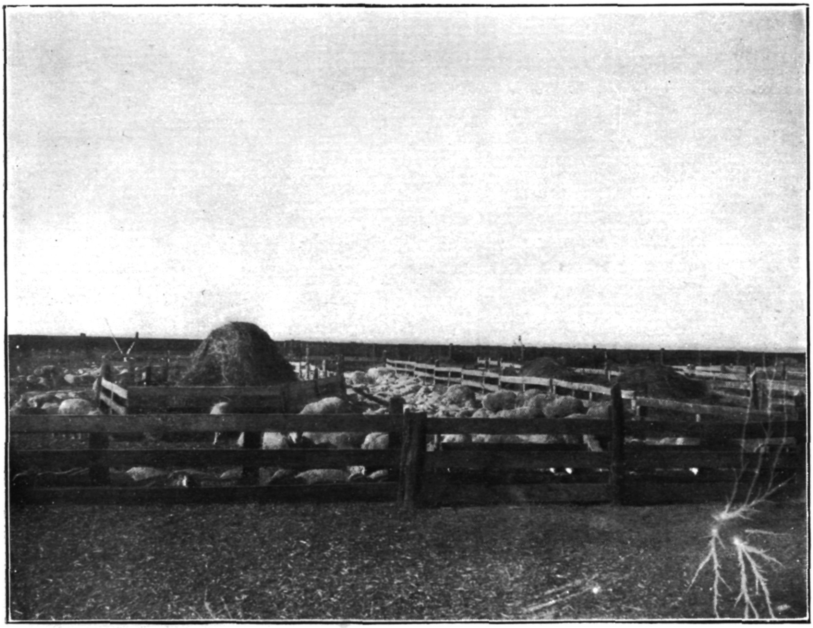


FIG. 1.—FEEDING CORRAL.

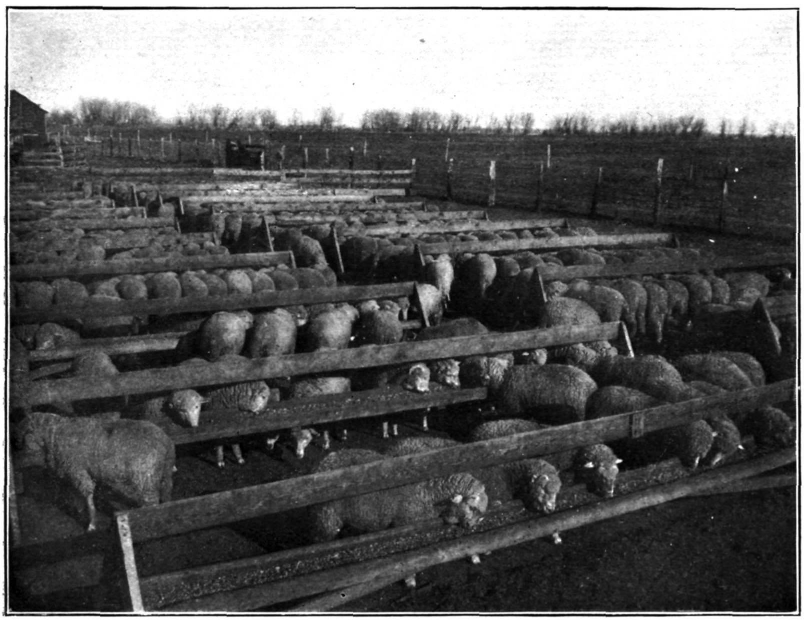


FIG. 2.—RACKS FOR FEEDING GRAIN.

and the crowded condition of the range. The undue increase in the number of sheep in a locality will, of course, be checked by the serious losses which must be experienced when such overcrowding of the range is carried too far. A natural equilibrium will therefore be maintained, at least in all localities where the larger part of the range is owned or controlled by local sheep men.

The number of sheep which can safely be maintained upon an acre is a question which has been extensively discussed and is still difficult to answer. The whole matter obviously depends upon the character of the grazing ground. In some localities an acre of ground will maintain two sheep during a whole season, while in other localities as much as 2 or 3 acres may be required for a single sheep. The amount of land required for a given number of sheep depends partly also upon the treatment which it received and upon the method of managing sheep as adopted by different flock owners. Where the sheep raiser is favorably located so that a suitable tract of land may be protected from grazing in the summer and reserved for winter use, and where care is exercised to prevent the destruction of available summer range by overgrazing, the present number of sheep may be safely increased to a slight extent. In other localities, however, the danger limit has already been passed and the range is being injured and rapidly reduced to a poor condition. This, however, is a matter which is thoroughly appreciated by the sheep men, and where the land is largely controlled by local men, so that tramp sheep can be successfully excluded, permanent injury to the range is being largely avoided. In certain parts of Montana, for example, where the land is entirely controlled by the local sheep raisers, the range has been so protected for the past fifteen or twenty years that apparently no deterioration has taken place in the quantity or quality of the forage. Under such conditions the business of sheep raising obviously rests upon a firm foundation and the owners may consequently expect reasonable profits from the business for many years to come.

As previously indicated, in localities where the land is not leased no individual or set of individuals can control the range, and the result is usually disastrous to the grass. Grazing land may be leased at one-half cent to 2 cents per acre, and in many localities may be bought at $3 to $4 per acre. Some sheep raisers maintain that the payment of even these small sums is sufficient to destroy the profits of the sheep business. This, however, seems unreasonable. A number of the more progressive sheep raisers, who lease or own nearly all the land upon which they graze, maintain that while the expense of sheep raising is somewhat increased, the range is better protected and the profits are correspondingly increased. The result is also more satisfactory on account of the stable condition in which the business is put and the confidence with which the sheep owners may look forward to a continuation of their business.

It is evidently impossible to continue indefinitely the free use of all public grazing lands. The gradual extension of sheep ranching has brought about the occupation of all public lands which are suitable for grazing. As long as no rights are acquired by any individual for the occupation of these lands, more or less serious conflict will occur, the profits of sheep raising will be reduced, and the prospects for the future will become worse and worse. It appears, therefore, that the only ultimate solution of the range question so far as sheep are concerned lies in the renting or purchasing of grazing land, so that it may be properly protected and made to yield a reasonable amount of forage; otherwise the time will soon come when a considerable reduction must be made in the number of sheep on the public range in order to prevent losses from weakness and starvation. In other words, sheep ranching, according to present range methods, has apparently reached a limit and in the future must be managed on a slightly different basis in order to insure continued profits. It does not seem reasonable to suppose that the payment of a moderate sum for rent or as a purchase price for land adds sufficiently to the expense of sheep ranching to destroy the profits of that business.

One frequently hears the statement from sheep raisers that their business is in the nature of a lottery venture—when all goes well the profits are very good, but losses of an extremely serious nature may occur when least expected. Some of these losses may be largely prevented by proper precaution. Losses from sheep scab may be controlled by dipping at proper intervals, and other simple diseases and their remedies should be well known to the sheep raisers. Losses from fall or spring snowstorms can usually be prevented by exercising special precaution during these seasons. It is well to be on the safe side and move the sheep down out of the mountains before the time for the occurrence of fall storms. As a guaranty against losses from spring storms it is desirable to provide a sufficient supply of hay to tide the sheep over periods during which they can not secure any forage upon the range. In some localities losses from poisonous plants are exceedingly severe, and suitable antidotes for these poisons have not been known until recently. The plants which cause the most extensive losses from poisoning are now fairly well known to the more progressive sheep raisers, and they can easily avoid localities in which those plants grow during the season of the year when the plants are actually poisonous. It may therefore be said that the dangers and risks connected with sheep ranching are perhaps not greater than those incurred in other business ventures, provided all possible precautions are taken to prevent the occurrence of disasters. When such precautions are taken the profits of sheep ranching under present range conditions are sufficiently great to tempt any individual with sufficient capital and industry to engage in this business.

WELSH MOUNTAIN SHEEP.

By George Fayette Thompson, M. S.,
Editor, Bureau of Animal Industry.

In Wales one frequently hears the remark concerning the Welsh Mountain sheep that "they make the best mutton grown in the world." A well-known firm of breeders of Hartford, Conn., in their efforts to find some breed of domestic animal that might thrive profitably on the hill farms of New England, determined to test the claims made for the mutton qualities of the Welsh sheep. Accordingly, they purchased 59 head (57 ewes and 2 rams) in Wales, in the neighborhood of Llanfairfechan, and they were shipped on the steamer *Toric* in the first week of March, 1902. The North Wales Chronicle, in mentioning this incident, says: "It is the first time that this breed of sheep has been exported, and, if they become acclimatized quickly, more sheep of the same breed will be sent to America."

The Bureau of Animal Industry received a communication from the Hartford firm, dated November 24, 1902, stating that at that time the sheep had met fully all their expectations. They recognize, however, that a longer time is required, in order to ascertain fully the adaptability of this breed for the hilly portions of New England.

As this appears to be the first importation of Welsh Mountain sheep into the United States, it will interest many, no doubt, to know something of their history, their description, and their special uses. Information of this kind is very brief in all works upon sheep, but such as is available is given herewith. The pictures (Pls. XIX and XX) are from photographs taken while the sheep were in quarantine at Athenia, N. J. A typical ram is shown on the left of Plate XIX and a typical ewe in the center of Plate XX.

HISTORY.

The Welsh Mountain sheep is a breed which is believed to be native to the soil of Great Britain, not only to the mountains of the principality of Wales, but to the valleys as well, and also to the mountains and valleys of some sections of England. Recent times have seen the Welsh sheep yield their place in England and in the lower lands of Wales to the larger breeds, and they have been driven into the mountains of Wales, where they have thrived as no other breed is able to thrive under like conditions. Yet it is true that there is a strong probability that this variety will ere long be only a memory, as his

original characteristics are being merged into those of the larger breeds.

At the present time it appears that there are three varieties of the Welsh Mountain sheep, namely, the sheep of the Higher Mountains, the Soft-Wooled sheep, and the Radnor sheep. It can hardly be doubted, however, that the two last-named varieties sprang by improvement out of the first named.

DESCRIPTION.

A description of the first variety is given in the language quoted below of Dr. W. C. Spooner:[a]

> The former [sheep of the Higher Mountains] is very small, seldom exceeding 5 pounds the quarter, with horns in both sexes resembling the goat, whose habits it otherwise resembles. The tail is of the usual length, and there is a ridge of hair on the back, throat, and dewlaps, and the fleece is of various colors—black, gray, and brown. These sheep are extremely active and wild, and prefer the highest spots and the aromatic plants found there to richer herbage. They abound mostly in south Wales. Like those of Orkney and Zetland, the rams often attack the ewes when in lamb and thereby diminish their number as if for the purpose of repressing their too great increase.
>
> They have black hair on the face and legs, a character which continues even in their improved state, as in the Radnor, a superior variety of the same race, enlarged by better pasturage. These sheep would be improved by crossing with either the Southdown or the Cheviot, though the hardier characteristics of the latter would probably render it more suitable for the purpose.

Another English work,[b] in speaking of the variety of the Higher Mountains of Wales, says that "attempts at crossing with improved varieties have failed." This view will not admit the assertion that the other varieties of the Welsh Mountain sheep are improvements upon the original brought about by crossing with the better breeds. This latter view is the contention of most writers on the subject.

That variety of these sheep known as the Soft-Wooled is now the distinctive sheep of Wales and is the breed usually referred to under the name "Welsh Mountain." The following description of this breed is from Henry Stewart:[c]

> The rams are horned, but the ewes rarely so. Their faces are white, rusty brown, speckled, or gray. The head is small and is carried high. The neck is long, the shoulders low, the rump high, the chest narrow, the sides flat, and the girth small. The average fleece yields about 2 pounds of wool.

Dr. W. C. Spooner gives the following description:

> These sheep are small, seldom exceeding 8 pounds the quarter when fat. They are spread throughout the whole of Wales, but delight in lofty situations. Like all mountain breeds, their habits are exceedingly active, and when inclosed few fences can confine them. Even when removed to distant spots they will not unfrequently escape and regain their native mountains.

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[a] The History, Structure, Economy, and Diseases of the Sheep, p. 11. 1888.

[b] Sheep: Domestic Breeds and Their Treatment, p. 55. 1896.

[c] The Shepherd's Manual, p. 125. 1880.

WELSH MOUNTAIN SHEEP.

WELSH MOUNTAIN SHEEP.

Their form corresponds to their habits, being slender throughout, and their hind quarters long, like those of the deer. The males have their horns curved backward, but the females do not possess any. The neck is thin and arched backward, like the deer, in a greater degree than any other sheep. They have a mixture of hair, though less than other mountain breeds, and this is particularly noticeable on the throat, where it appears like a beard. The fleece weighs between 1 and 2 pounds.

These sheep are hardy and prove to be good nurses to their lambs. They rarely produce more than one lamb at a time, unless crossed with improved breeds.

A word as to the Radnor variety will be sufficient. There is, in fact, the Old Radnor and the improved sort now generally called the "Radnor." While some of the characteristics of this variety are like those of the Soft-Wooled, it resembles more the Higher Mountain variety. It is larger, however, and of better form. It may be fattened to weigh 8 or 9 pounds to the quarter. Crosses have been produced with Shropshire and other breeds.

SPECIAL USES.

The flesh.—The Welsh Mountain sheep is quite small, yielding from 5 to 8 pounds to the quarter of dressed meat. The crosses of the ram of the larger breeds upon the ewes of this one have increased the size of the animal, and it would appear from the demand for the mutton thus produced that the peculiar flavor that is characteristic of the Welsh Mountain is still present. "Welsh mutton" is considered as one of the rarest delicacies of the Englishman's table, and in the grocers' shops it sells at two or three times the price of ordinary mutton. One writer says: "The mutton is famous for its delicacy, and is held in high esteem in the London markets, taking rank with Scotch Blackfaced and Southdown." Henry Stewart says: "It is a small, restless, exceedingly active sheep, white-faced, with a carcass yielding a quarter of 12 pounds or less, but of such tenderness of flesh and high agreeable flavor, equal to that of venison, and which brings in the shops of the English cities as much as a dollar a pound at the Christmas holidays and half as much at other seasons."

A correspondent, C. H. D., who furnished the Weekly Live Stock Report, of Chicago, with a letter dated at London, May 3, 1902, refers to some recent experiments with crossbred lambs of the Welsh Mountain breed, and from this letter the following is quoted:

A series of experiments in sheep breeding has been conducted by the agricultural department of the University College of North Wales, with the object of ascertaining the most suitable cross with Welsh Mountain ewes for the production of fat lambs. In the year 1899 rams of the Wiltshire, Shropshire, and Leicester breeds were used, and of these the Wiltshire gave the most satisfactory results. The lambs of this cross weighed heavier and fattened earlier than those of either of the other crosses. The lambs of the Leicester cross fattened almost as early as those of the Wiltshire cross, but they were deficient in weight, and in the

case of the Shropshire cross, although they weighed heavier, they were slower in maturing than those of the Leicester cross. Similar experiments were continued during the next season, except that a Southdown ram was substituted for the Leicester. The rams were turned in with the ewes on October 5 and were removed on November 30. From that date until the lambs were sold the various lots were grazed on the same land, so that the feed could not be responsible for any difference in results. At the time the lambs were slaughtered their average live weights were almost identical—68 pounds in the case of both the Wiltshire and the Shropshire crosses, and 67 pounds in that of the Southdown cross. The lambs were judged by two experts, a butcher and a dealer. As regards ripeness of condition they decided in favor of the Wiltshire cross, although in this respect the Southdown cross was a close second. The Wiltshire cross showed a greater aptitude for fattening than the others, and possessed a much more finished appearance, which is of great importance in the case of lambs. The Southdown cross produced fat lambs of excellent quality, but they were smaller than the others. Their smallness, however, establishes the fact that this is a very good cross where the ewes are small. Apart from their quality, the fact that the lambs at birth had small heads and light shoulders is a strong recommendation in their favor, as a great deal of the mortality in the case of small ewes is often caused by their being unable to deliver their lambs.

The wool.—The fleece of the pure Welsh sheep weighs from 2 to 3 pounds. This increases in weight considerably in crosses with the wool-bearing breed, and it is a staple of fine quality. It has, however, a mixture of hair, which tends to diminish its value. A peculiar characteristic of this wool is that it never shrinks,[a] and it is this wool from which the popular Welsh flannels are fabricated. It is said, too, upon good authority, that the durability of this wool exceeds that of the wool of all other breeds. It is usually homespun, and is woven at home into all sorts of clothing. The cloaks, all dyed red, which are worn so universally by the women are made of this wool.

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[a] Henry Stewart, The Shepherd's Manual, p. 125.

FEEDING NATIVE STEERS.

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INTRODUCTION.

The investigations herein detailed were commenced in the winter of 1900. The results of the preliminary investigation were published in Bulletin 4, Vol. XIII, Tennessee Agricultural Experiment Station; and as feeding experiments with native steers were carried on during the winters of 1901 and 1902, the experiments now cover a period of three years, and show the results of feeding 38 head of cattle. Sufficient data have now accumulated to enable some important conclusions to be safely drawn from these investigations.

PUBLIC SENTIMENT AT FAULT.

The feeding of cattle has not been engaged in as extensively in the middle South as the natural conditions would warrant, owing to the frequent though ill-founded belief that the winter feeding of cattle could not be made a profitable industry because of the limited supply of corn available for feeding purposes. There is no reason why much more corn should not be grown without increasing the present area by improving the culture now given the land, though if the present corn crop were properly supplemented by the judicious use of cotton-seed meal, it would already suffice to feed many thousand head of cattle that are now shipped out as store cattle. The soil and climate of the State are peculiarly well adapted to the production of winter cereals, such as barley, oats, wheat, and rye. In the following table are shown the results obtained from growing these crops for three years on ordinary upland soils, such as prevail on nearly every farm. These results must fully convince every farmer of the importance of cultivating more winter cereals, which not only prevent the washing of the land, as they act as cover crops, but also provide an abundance of supplemental grain for feeding with cotton-seed meal and corn.

Average yield of cereals in Tennessee, 1900 and 1901.

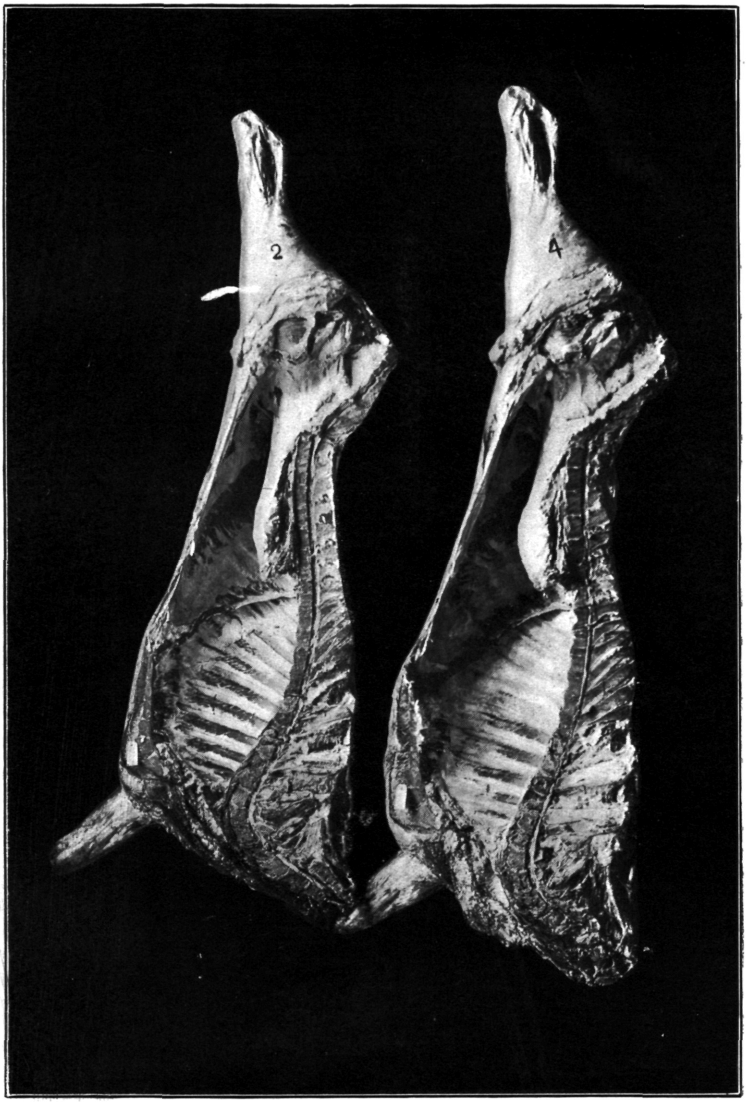
Year.	Barley.	Oats.	Wheat.	Rye.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
1900	56.7	39.3	41.7	51.8
1901	44.0	32.9	32.5	37.7
Average	50.4	36.1	37.1	44.7

These crops were grown on a fair type of upland clay soil. The yield of barley for the two years was 50.4 bushels; oats, 36.1 bushels; wheat, 37.1 bushels; rye, 44.7 bushels, so there is no reason why the farmer should not have an abundance of cheap grains to feed beef cattle. If cereal grains are at present too expensive to feed, it is because an insufficient area of these crops is grown, or because the better cultural methods are not followed, and not because they will not grow. With careful culture the present area of land devoted to cereals should yield much larger crops than at present, and then the difficulty of supplying a grain supplement for beef production would be solved. The remedy is in the hands of the farmers, and existing conditions should no longer be permitted to keep them from feeding beef cattle.

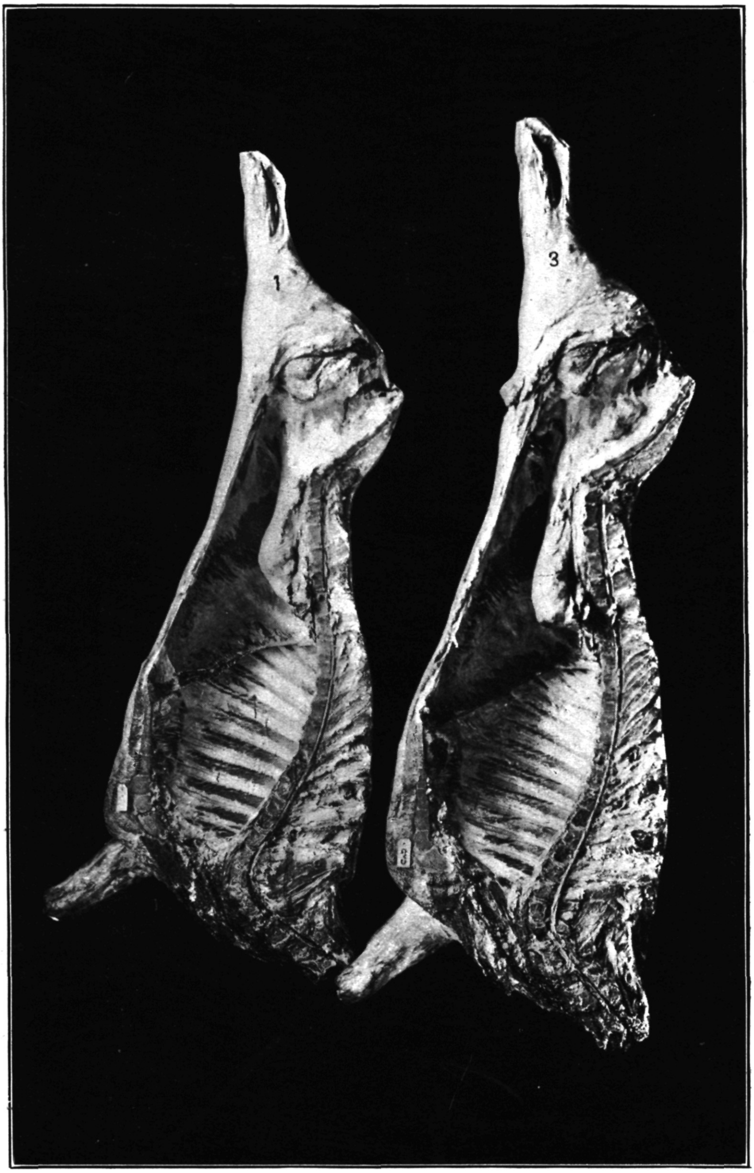
Winter-grown cereals may also be utilized for hay making, as well as grain growing. For example, winter barley in the year 1900 yielded as high as 2.3 tons per acre, at a cost of $5.96 per ton; winter wheat, 3.37 tons, at a cost of $4.73 per ton; winter wheat and vetch, 3.72 tons, at a cost of $4.78 per ton; and winter wheat, oats, and barley, 2.96 tons, at a cost of $5.37 per ton. Suitable food stuffs for feeding beef cattle can be plentifully produced in the South at a reasonable cost.

IMPORTANCE OF THE CATTLE INDUSTRY IN THE STATE.

Our farmers spend about $1,500,000 annually for fertilizers. There are, in round numbers, 1,000,000 head of cattle of all classes in the State. The droppings from a single one of these, according to the results obtained at the Ontario Agricultural College, are worth about $40 a year, so that an appalling waste is going on when one considers how insignificant an amount of stable manure is being utilized on our farms. If only one-quarter of the value of the droppings of the cattle held in the State was utilized as it should be, it would wipe out the fertilizer bills now incurred by our farmers twice over. These figures indicate how very important it is that the cattle now grown in the State be retained and finished within its borders. It is quite evident that the foreign buyer must make a profit on these cattle, or else he would not continue to purchase them. Reliable information shows that many of the cattle now sold out of the State go to Pennsylvania and Maryland and other Northeastern States for winter feeding. It is evident to one familiar with the topography of the country that it is not possible to produce crops for cattle feeding of a better variety and character or on a more economical basis in Maryland and Pennsylvania than in Tennessee, and it is also well established that the man who places a highly finished animal on the market derives the greatest profit therefrom. That beef cattle can be grown in the State to the material advantage of the farmer is



SIDES OF BEEF SHOWING INFLUENCE OF DRY AND SUCCULENT RATIONS ON CHARACTER OF THE CARCASS.



SIDES OF BEEF SHOWING INFLUENCE OF DRY AND SUCCULENT RATIONS ON CHARACTER OF THE CARCASS.

FIG. 1.—LOIN AND ROUND FROM GROUP III.

FIG. 2.—LOIN AND ROUND FROM GROUP IV.

FIG. 1.—LOIN AND ROUND FROM GROUP V.

FIG. 2.—LOIN AND ROUND FROM GROUP VI.

shown by the fact that properly finished cattle topped the market in Louisville last winter on several occasions, and recently 98 head were sold by a Knoxville feeder for export to Scotland. As the industry, comparatively speaking, is in its infancy, it is not to be expected that great success in cattle feeding will be achieved all at once by our farmers. It is a business which requires the exercise of good judgment and the closest personal attention, and so it will take time properly to develop it.

SCOPE OF THE WORK IN HAND.

The object of the present investigations has been to try to show the farmers why they should engage more extensively in cattle feeding, and the results are certainly very gratifying. There is an unreasonable prejudice against the feeding of silage, but the experiments show that it is the cheapest and best food that can be utilized. As already indicated, sufficient grain can be produced cheaply enough when combined with cotton-seed meal to solve that part of the problem; and as Tennessee cattle of high quality have already been successfully shipped to foreign markets, that is no longer a difficulty. Furthermore, it is evident that by feeding cattle and properly utilizing the excrements, our fertilizer bills can be saved and the mechanical condition of our soils very much improved by the use of barnyard manure. Nature intended that stock husbandry should be one of the principal industries of the State. To be convinced of this one need only look out upon the marvelously diversified and well-watered landscape.

Finally, the prevailing prices for live stock indicate that it will be an unusually profitable industry for the next few years at least. The writers firmly believe that beef will never be as cheap in America again as it has been in the past. This opinion is based on the history of animal industry in foreign countries, and in Europe in particular. While the producing capacity of the United States is only partially developed, the range country is exhausted, and the cheap making of beef can never be carried on in the future as it was in the past. Environment makes it necessary that the larger per cent of live stock must in the future be grown by the small farmer, which makes the reorganization of our whole agricultural economy a matter so portentous and far-reaching in its influences that it will take some years to accomplish it. For these very grave and substantial reasons our farmers should give the live stock industry their most serious attention, as it bids fair to be the most profitable business they can engage in, as it will enable the restoration of our worn-out lands—the most vital and vexing problem before our people. There will be difficulties in the way of developing stock husbandry, but they can be surmounted. The fact that one man can overcome them successfully is an evidence

that other men can, if they will give the business the same time and attention and exercise the same degree of skill and judgment in their work.

OUTLINE OF THE INVESTIGATIONS.

The plan of the experiments for the three years under discussion is set forth in the following table:

Experiment of 1900.

Group.	Roughness.	Concentrates.
I.	Shredded corn stover	Cowpea hay and corn meal.
II.	Shredded corn stover	Corn meal.
	Cotton-seed bran	Cotton-seed meal.

Two groups of cattle were fed in 1900, as indicated above. The object was to determine to what extent shredded stover could be fed and whether it would be profitable to so utilize it or not; and, second, to determine the value of cowpea hay and corn meal as compared with cotton-seed bran—that is, ground hulls and cotton-seed meal. Cotton-seed meal and bran, the title by which the last-named mixture is generally known, was a product at that time being put on the market supposed to correspond in composition to the undecorticated cotton-seed cake fed so extensively in Great Britain, and hence the determination of its relative feeding value was a matter of great importance to our stockmen. There was also another object in view, namely, to determine how nearly the farmer could utilize a home-grown ration successfully in steer feeding. In the above experiment the cotton-seed bran and cotton-seed meal were not mixed together before feeding. The results of using this food were unsatisfactory, and shortly after the experiment commenced it was found necessary to substitute corn stover for part of the cotton-seed bran in order to get the cattle to make any gains. The manufacturers thought that the cotton-seed bran and the cotton-seed meal should have been mixed together and that the results would have been different, and hence in one of the experiments of 1902 the mixture was fed as they suggested.

Experiment of 1901.

Group.	Roughness.	Concentrates.
III.	Shredded corn stover	Cowpea hay and corn meal.
IV.	....do	Cotton-seed meal and corn meal.
V.	Sorghum and corn silage	Cowpea hay and corn meal.
VI.	....do	Cotton-seed meal and corn meal

The object of the experiment of 1901 was to compare the value of the protein in the cowpea hay and cotton-seed meal and to determine the relative value of shredded stover and silage in beef production. There is an unreasonable prejudice in the minds of many farmers, as well as buyers and butchers, against the feeding of silage to beef cattle. Many farmers claim that they can not make satisfactory gains from the use of silage. In every case reported, so far as the writer can learn, the silos were improperly constructed and the silage sour, watery, and unsatisfactory as a feed. Buyers object to silage-fed cattle because they say they shrink so much more than other cattle when put on grass or shipped long distances, and the butchers objected because they thought they would not dress out as high a per cent of valuable meat as the dry-fed cattle. While the investigations may not have covered the second objection fully, they have shown that the other two were not well founded, as where silage of good quality was properly fed unusually large gains could be made at less cost than where shredded stover was employed. These matters are discussed in some detail further on.

Experiment of 1902.

Group.	Roughness.	Concentrates.
VII.	Silage and cowpea hay	Corn meal and cotton-seed meal.
VIII.	Stover (shredded) and cowpea hay	Do.
IX.	Silage and cowpea hay	Cotton-seed meal and bran.
X.	do	Do.

The object of the experiment of 1902 was to determine the relative value of dry and succulent roughness when fed with corn meal and cotton-seed meal, and cotton-seed meal and cotton-seed bran. A small amount of cowpea hay was fed to all groups in the belief that it would add variety and palatability to the ration. As indicated in the experiment of 1901, corn meal and cotton-seed meal form one of the finest combinations that can be utilized as concentrates for feeding with silage or stover for the economical production of beef in the middle South.

PRICE OF FOODSTUFFS.

The profit from feeding any kind of food will be measured by these facts: The prevailing market prices, the physiological effect on the animal, and the percentages of the various digestible food factors it contains. Unfortunately, but little attention is given to any of these except the first, and as the market prices have varied widely during the three years of the experiment—being quite reasonable in 1900 and 1901 and extremely high in 1902—the results have been discussed

with two sets of prices, known as high and low prices. The facts brought out are fair to all the food stuffs concerned, and will enable the reader more easily to determine the relative value of the different ones and the prices he can afford to pay for them in order to utilize them profitably in stock feeding. Not all of these have a strictly market value, corn stover and silage being two notable examples. According to our experience and that of other farmers in the State, it costs about $3.50 to $4 per ton to produce corn stover; to bale it and place it on the market would cost about $3 more; and it would ordinarily retail for about $7 a ton. Cowpea hay can be produced at $4 to $5 per ton. The average market price for the State is about $10, and it would cost the farmer practically the same to put it on the market as corn stover. The figures used for silage under low prices indicate the actual cost of producing a ton of the silage used in these feeding experiments, while $2.50 has been adopted for the high price, as silage is not strictly a commercial article. By using these two sets of prices, which indicate the farm value of some crops and the market prices that would ordinarily have to be paid for others which must be purchased, the disposition that should be made of certain food stuffs has been more clearly brought out, as it is possible to show the value from feeding some crops as compared with the market prices, and hence the manner in which they should be utilized in order to insure the greatest profit.

Kind of food.	High prices.	Low prices.
Experiment of 1900:		
Corn meal	$14.00	$10.75
Cotton-seed meal	20.00	20.00
Cotton-seed bran	14.00	14.00
Cowpea hay	10.00	7.00
Corn stover	7.00	4.00
Experiment of 1901:		
Corn-and-cob meal[a]	14.00	11.00
Corn meal[b]	17.25	14.00
Cotton-seed meal	22.00	22.00
Cowpea hay	10.00	7.00
Stover	7.00	4.00
Silage	2.50	1.70
Experiment of 1902:		
Corn meal	28.00	24.75
Cotton-seed meal	24.00	24.00
Cotton-seed meal and cotton-seed bran	20.00	20.00
Cowpea hay	10.00	7.00
Stover	7.00	4.00
Silage	2.50	2.10

[a] Fed for 51 days. [b] Fed for 69 days.

RATIONS.

The rations fed per day at the beginning and at the close of the experiment are shown in the following table. The rations were fed per 1,000 pounds of live weight:

Daily ration fed per 1,000 pounds of live weight.

Group.	Kind of food.	Pounds fed.			
	Experiment of 1900:		*Beginning.*		*Close.*
I.	Corn meal		3		11
	Cowpea hay		6		10
	Corn stover		8		6
		1st period.		*2d period.*	
II.	Corn meal			4	7
	Cotton-seed meal	4–7		3	5
	Cotton-seed bran	6–16		6	8
	Corn stover	8		8	6
	Experiment of 1901:				
III.	Corn meal		4		8
	Cowpea hay		6		9
	Corn stover		8		6
IV.	Corn meal		4		8
	Cotton-seed meal		2		3
	Corn stover		8		8
V.	Corn meal		4		8
	Cowpea hay		6		4
	Silage sorghum [a]		30		[b] 36
VI.	Corn meal		4		8
	Cotton-seed meal		2		3
	Silage sorghum [a]		30		[b] 46
	Experiment of 1902:	*1st period.*		*2d period.*	
VII.	Corn meal	1	5	2	9
	Cotton-seed meal	2		1	
	Cowpea hay		6		4
	Silage corn [c]		30		30
VIII.	Corn meal	1	5	2	9
	Cotton-seed meal	2		1	
	Cowpea hay		6		6
	Stover		8		7
IX.	Cotton-seed meal 52, Cotton-seed bran 48	[d] 4		6	9
	Cowpea hay		7		5
	Silage corn [c]		30		30
X.	Cotton-seed meal	[d] 4		6	9
	Cotton-seed bran				
	Cowpea hay		7		7
	Stover		8		7

[a] Sorghum silage substituted for corn at end of 60 days.
[b] Corn.
[c] Corn silage 30 days.
[d] Cotton-seed meal and cotton-seed bran substituted for cotton-seed meal at end of 30 days.

In the case of Group II a number of changes in the arrangement of the cotton-seed meal and cotton-seed bran became necessary, as the

animals got off feed and would not eat the mixture, and at the end of the second period it was found necessary to reduce the amount of cotton-seed bran and replace it with stover, as it produced indigestion. In the case of Groups V and VI corn silage was fed for the last 60 days in the place of sorghum silage. In Groups VII and VIII the corn meal and cotton-seed meal at the beginning of the ration were mixed 1:2, making a very narrow ration. The ration was gradually reversed until during the last period they were receiving 2 parts of corn meal to 1 part of cotton-seed meal, making the ration considerably wider.

The object of arranging the foods as indicated was to compare the influence of feeding a narrow ration at the beginning and a wide one at the close and a wide ration at the beginning and a narrower one at the close, as was done in all the groups in the experiment of 1901. In the case of Groups IX and X the cotton-seed meal and cotton-seed bran were mixed in the proportion of 52 per cent of meal to 48 per cent of bran. Owing to an unfortunate delay in transit it was necessary to feed cotton seed meal for the first few days. Corn silage was also fed for the first 30 days in the place of sorghum silage.

METHOD OF FEEDING PURSUED.

The steers were all dehorned and were stall fed. They were kept out of doors when not eating, except in very bad weather. The rations were fed in two parts—at 6 a. m. and at 5 p. m.—and the animals were watered at the same time. All the foods used were in a palatable condition and were eaten with relish by the steers. The animals were kept free from lice and vermin by the use of an insecticide, and those parts of the body on which the manure is liable to accumulate were kept clipped so as to keep the animals in a comfortable condition all the time. Four animals were fed in all groups except Groups VI and X, which contained only three animals. This was due to the fact that additional stall room could not be obtained for an extra animal, or all groups would have been made uniform.

GAIN IN LIVE WEIGHT; THE "FILL-UP."

Groups I and II were fed 91 days, the remainder being fed 120 days. This did not include a preliminary feeding period of 7 days,[a] the time required to get the animal's system under the full influence of the food stuffs. The table indicates the pounds of gain and the amount of "fill-up" made by the different groups during the preliminary feeding period, and also shows what effect it would have had on the daily rate of gain if it had been included. If the feeder can buy poor, thin animals he gets the full benefit of the "fill-up," and it is to his interest to purchase them when they are poor and thin for that reason.

[a] 14 days in the experiments of 1902.

It is not to the interest of the seller to place his animals on the market in any such condition. The "fill-up" is of considerable importance from an experimental standpoint, as it explains why so many farmers secure such unusually large gains that at first sight seem to be unreasonable and are at variance with the records of experimental investigation. The writer has often heard it said that farmers could make a larger gain than was done by the experiment station, but it is easy to understand how they do so by referring to the table showing the "fill-up" made by the different groups in the seven days, amounting in some instances to 246 pounds with Group IX. All the cattle in the experiment of 1902 were on preliminary feeding for 14 days. This, added to an already satisfactory daily gain, makes an unusually large gain. While the "fill-up" is profitable to the feeder, he should distinguish between that and gain in live weight, which is much more difficult to make and which could rarely if ever be made in the time and at the rate indicated. Table I also shows how in a short feeding period of 90 days unusually large gains per head per day may be made and the animals still remain in only fair market condition, being neither well fattened nor properly finished.

TABLE I.—*Increase in live weight.*

Group.	Number steers in group.	Number days fed.	Weight.			Gain by periods.					Gain.			
			Preliminary.	Initial.	Final.	Preliminary.	First thirty days.	Second thirty days.	Third thirty days.	Fourth thirty days.	Total, including preliminary feeding.	Average per steer per day.	Total for experiment proper.	Average per steer per day.
			Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*[a]	*Lbs.*[b]	*Lbs.*[b]	*Lbs.*[c]	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
EXPERIMENT OF 1900.														
I	4	91	3,039	3,185	3,825	146	63	235	182	160	786	2.0	640	1.8
II	4	91	3,111	3,210	3,801	99	120	260	290	161	690	1.8	591	1.6
EXPERIMENT OF 1901.														
III	4	120	3,483	3,516	4,121	33	188	160	92	165	638	1.3	605	1.3
IV	4	120	3,473	3,448	3,971	25	153	145	68	157	498	1.0	523	1.1
V	4	120	3,430	3,556	4,284	126	238	180	173	137	854	1.7	728	1.5
VI	3	120	2,593	2,648	3,388	55	273	230	92	145	795	2.1	740	2.1
EXPERIMENT OF 1902.														
VII	4	120	3,010	3,200	4,086	190	244	169	227	246	1,076	2.0	886	1.9
VIII	4	120	3,005	3,223	3,928	218	173	123	254	155	923	1.7	705	1.5
IX	4	120	2,945	3,191	3,853	246	215	127	185	135	908	1.7	662	1.4
X	3	120	2,190	2,386	2,808	196	99	99	131	93	618	1.5	422	1.2

[a] Twenty-one days. [b] Twenty-eight days. [c] Fourteen days.

IMPORTANT DIFFERENCE BETWEEN "FILL UP" AND GAIN.

Finally, it is important that the feeder recognize the difference between "fill up" and gain; for, as our cattle improve in quality and are brought into better condition during the "store state," the "fill-up" will be a matter of less consideration, and many feeders who have depended on it to make them a gain of 90 to 100 pounds per head will be at a loss to understand why their daily gains are small, and they will become dissatisfied with steer feeding because they can not make large enough gains, as they think, to make it profitable. The gain from the "fill up" has not been regarded in the following discussion, but was introduced only to call attention to a matter of very great importance and one which is generally misunderstood.

GAINS BY PERIODS.

Besides presenting the initial and finished weights of each group, the gain by periods is also shown. Excellent gains were made by all groups during the first period, except by Groups I and II, which did not seem to take kindly to the foods offered. In the case of Group II this was accounted for by the cotton-seed bran already referred to. As a rule, the best gains were made in the first 30 days of feeding, though a study of all the groups shows that they held up well and were making very satisfactory gains at the end of 120 days. Groups I and II made a good total gain—better, in fact, than a number of those that were fed for 120 days. This was largely due to their being in poorer condition than any of the other cattle fed. The steers fed in 1901 were in fair condition when the experiment commenced, while those used in 1902 were in the best condition of any of the animals fed. Leaving out of consideration the preliminary feeding period, they made more satisfactory gains than any of the other groups.

SILAGE, CORN MEAL, AND COTTON-SEED MEAL.

The largest increase per group and the largest gains per individual were made by Groups VI and VII—740 and 886 pounds, respectively. These animals were fed silage, corn meal, and cotton-seed meal, and made an individual gain of 2.1 and 1.9 pounds for the entire feeding period of 120 days. Seven animals were fed this ration, which stands out clearly as the most satisfactory combination used in point of palatability and gain in live weight. The next best gains were made by Groups I and II, the former receiving corn meal, cowpea hay, and stover, and the latter corn meal, cotton-seed meal, and stover. Group II would have made a better showing if the corn meal and cotton-seed meal had been used during the first period. Judging from our experience in feeding stover—that is, a dry ration—for 120 days it is not reasonable to suppose that Groups I and II would have held these gains for a period of 120 days any better than did Groups III, IV, VIII, and X, which were fed corresponding rations. The satisfactory

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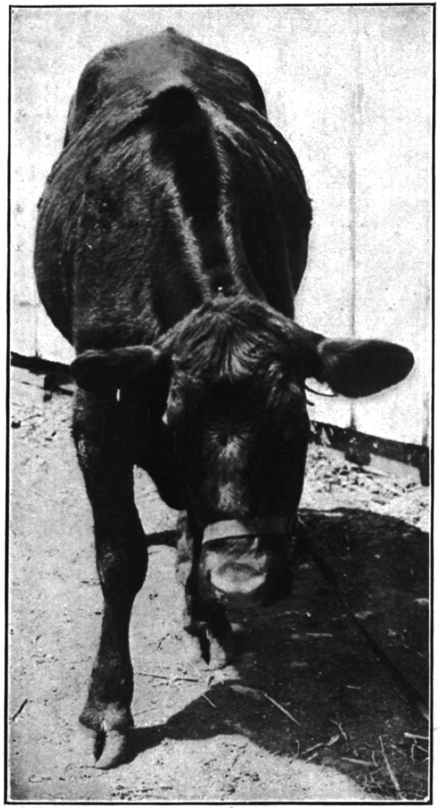

FIG. 1.—ANIMAL IS TOO FLAT IN THE RIBS AND NARROW ON THE BACK.

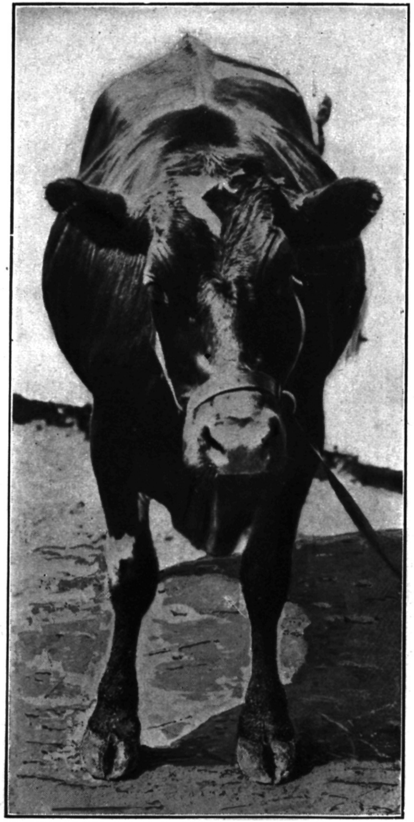

FIG. 2.—ANIMAL HAS WELL-SPRUNG RIBS AND A GOOD BACK AND WAS AN EXCELLENT FEEDER.

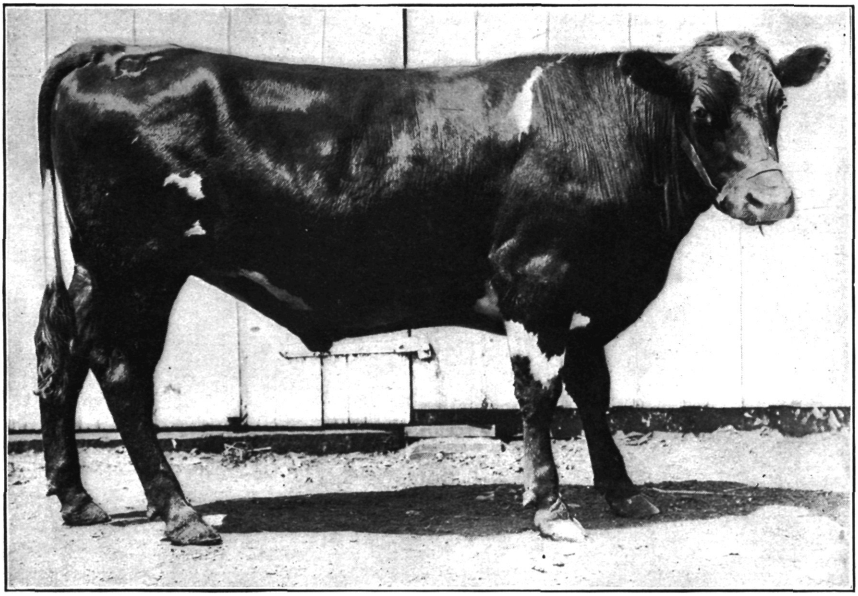

Fig. 1.—A Good Type of Feeder, Showing Plenty of Depth.

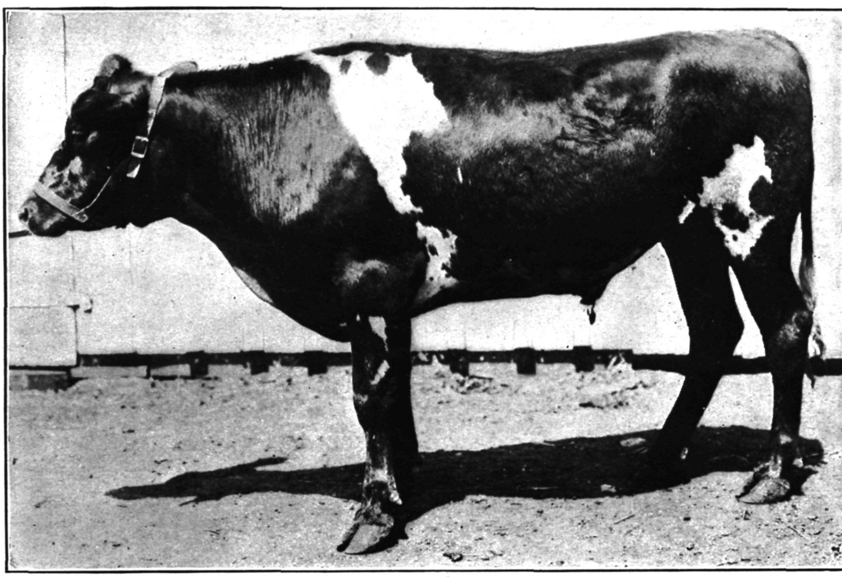

Fig. 2.—A Poor Type of Feeder, Lacking in Depth.

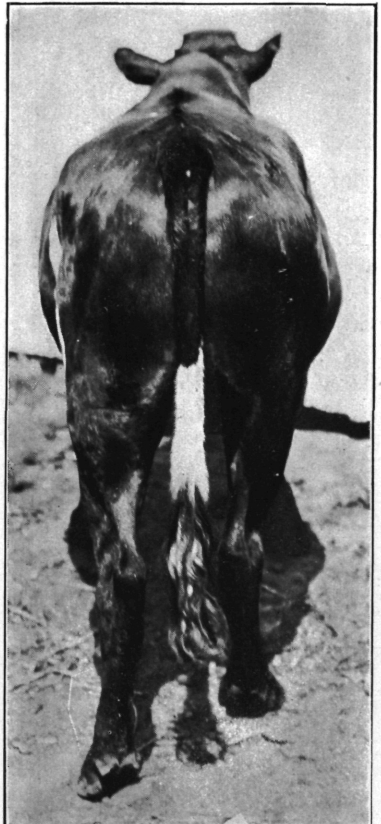

FIG. 1.—BACK OF A GOOD FEEDING TYPE AS SEEN FROM THE REAR.

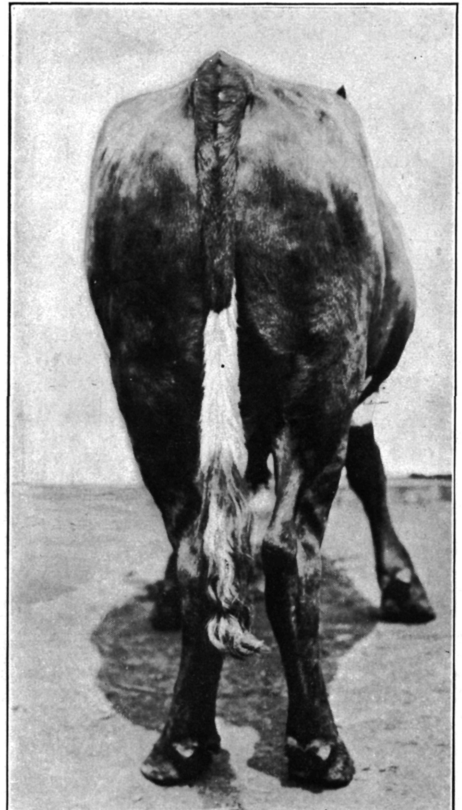

FIG. 2.—A WELL-DEVELOPED HIND QUARTER.

FIG. 3.—TOO NARROW IN THE QUARTERS AND BADLY CUT UP IN THE TWIST.

gain made by Group V—1.53 pounds per day and a total of 728 pounds for the feeding period on silage, cowpea hay, and corn meal—makes it evident that cowpea hay can be substituted for cotton-seed meal to advantage, and that while it will not give quite such gratifying results as cotton-seed meal, its use as a substitute for cotton-seed meal will be determined by the cost of the former's production and market price of the latter. If the farmer wishes to avoid the purchase of cotton-seed meal, he could utilize cowpea hay to good advantage, the principal trouble with it being the difficulty of getting the cattle fed on succulent foods to eat enough of it. It is evident that silage when fed with cotton-seed meal and cotton-seed bran is not nearly as satisfactory a feed as corn meal and cotton-seed meal—witness the gain of 1.38 pounds per head per day made by Group IX, fed on that combination. Group VIII, which received stover, pea hay, corn meal, and cotton-seed meal (a dry ration), made a gain of 1.48 pounds per head per day, or a total of 705 pounds for a feeding period of 120 days.

GOOD GAINS BY NATIVE CATTLE.

The fine showing made by Groups I and II was partially due to the manner of selling these animals. The cattle in 1900 received their full ration the morning on which they were sold, whereas in the years 1901 and 1902 they received food but no water that morning. While the animals were driven practically the same distance, the results, of course, were certainly in favor of the cattle in Groups I and II. A sufficient number of animals were used in the various experiments to show that satisfactory gains were made when suitable rations are used, even with our native cattle. In six of the groups a gain of practically 1.5 pounds per day was made throughout the entire feeding period, a gain that would compare very favorably with that made by animals of better quality; but as these animals did not dispose the flesh on those parts of the body where the most valuable meat is found and were coarser in bone and contained more offal, they did not take on the high finish of animals of better quality, nor does the meat bring such a high price, because of the tendency of such animals to develop largely in the fore quarter. It is quite evident that with animals of good quality and the foodstuffs at hand, the Southern farmer can make not only satisfactory gains, but place on the market an animal of high finish and one that will sell well. The principal thing needed in order to insure the profitable feeding of beef cattle in the State is the improvement of our native cattle by crossing the same with pure-bred sires of high quality.

LENGTH OF FEEDING PERIODS.

With regard to the length of feeding periods, it is evident that where animals are making a gain of 2.1, 1.9, 1.5, and 1.4 pounds

per day they can be fed for that length of time to advantage, or even for longer periods. It is our belief that these animals would show a profitable gain up to 150 days, as they were in a growing, thriving condition when sold. It is to the best interest of the Southern farmer to commence feeding his cattle not later than the first of December, possibly the middle of November. Then, if he feeds until the 15th of April, he could easily get in a feeding period of 150 days during cool weather and be ready to turn his cattle off at a good time of year. If he has an abundance of silage and utilizes cotton-seed meal and under certain conditions cowpea hay with corn meal or such other winter cereals as he can easily grow, he can make a fair profit from feeding native cattle. Then, by improving the cattle in the several communities through the introduction of improved sires on the cooperative plan, the business can be made permanent.

RESTATEMENT OF RESULTS.

The above results, stated in another way, will help to make clearer the previous exhibit concerning the gains of the cattle:

Fed dry ration—corn stover.			Fed succulent ration—silage.		
Group.	Gain in 120 days.	Gain per day.	Group.	Gain in 120 days.	Gain per day.
	Pounds.	*Pounds.*		*Pounds.*	*Pounds.*
III	605	1.3	V	728	1.5
IV	523	1.1	VI	740	2.1
Total	1,128	1.2	Total	1,468	1.8
VIII	705	1.5	VII	886	1.9
X	422	1.2	IX	662	1.4
Total gain	1,127	1.35	Total gain	1,548	1.65
Grand total	2,255	1.27	Grand total	3,016	1.75

The above statement considers only the cattle fed in 1901 and 1902, as they were all fed for a period of 120 days. The average of the four groups fed dry and succulent rations, respectively, includes the results from 15 cattle in each instance. The gains made by the cattle in 1901 and 1902 did not vary materially. It is fair to average up the results, because all the groups receiving stover and succulent food were fed corresponding grain rations, and the difference shown in the gain must be largely attributed to the nature of the roughness employed. While the 15 cattle receiving the dry ration made a very fair average gain—namely, 1.27 pounds for the whole period of 120 days—the animals receiving the succulent ration did much better, making an average gain of 1.75 pounds for the whole period, so that the results are clearly in favor of the cattle receiving silage.

CONSUMPTION OF ROUGHNESS AND CONCENTRATES.

The amount and kind of roughness and concentrates consumed by the different groups is shown in Table II in order that the reader may inform himself as to the amount of food required to secure the gains per group shown in Table I. It will also help him to ascertain the amount of food of different kinds he would need to have on hand for animals of the weight indicated for a given length of time.

TABLE II.—*Food consumed.*

Group.	Roughage.			Concentrates.		
	Silage.	Shredded corn stover.	Cowpea hay.	Corn meal.	Cotton-seed meal.	Cotton-seed meal and cotton-seed bran.
EXPERIMENT OF 1900.						
I	----------	1,409.8	3,088.3	2,349.7	----------	----------
II	----------	1,285.5	----------	839	1,487.4	[a] 3,563
EXPERIMENT OF 1901.						
III	----------	2,627.25	3,620.25	2,906.5	----------	----------
IV	----------	3,448.75	----------	2,944	1,192.25	----------
V	15,639.5	----------	1,636.75	3,042	----------	----------
VI	13,849.5	----------	----------	2,333.75	972.75	----------
EXPERIMENT OF 1902.						
VII	12,893.5	----------	2,047.75	1,871.5	1,740	----------
VIII	----------	2,650.75	2,843	1,905	1,757	----------
IX	13,406	----------	2,404	----------	587	[b] 2,910
X	----------	1,819.5	2,332.75	----------	444	[b] 2,182.5

[a] Cotton-seed bran only.
[b] 52 per cent cotton-seed meal and 48 per cent cotton-seed bran.

FOOD EATEN PER POUND OF GAIN.

Table III shows the amount of food consumed per pound of gain, and enables one to study the influence of the roughness on the amount of concentrates required for 1 pound of gain. As the concentrates are the expensive part of the ration, a combination of foodstuffs that tends to reduce the amount required becomes a matter of vital importance to the feeder.

While the smallest amounts of roughness and concentrates were consumed by Group I, it must not be forgotten that these animals were fed for 91 days only, and, according to the table of live weights, they did not make as good gains during the last 30 days as in the first 60. Even for the shorter feeding period, Groups I and II consumed but little less concentrates per pound of gain than Groups VII, V, and VI, which were fed silage. Group VII, which consumed 4.1

pounds of concentrates for 1 pound of gain, was fed cotton-seed meal and corn meal.

TABLE III.—*Food consumed per pound of gain.*

EXPERIMENT OF 1900.

Group.	Roughage.			Concentrates.			Totals.	
	Silage.	Stover.	Cowpea hay.	Cotton seed bran.	Cotton-seed meal.	Corn meal.	Roughage.	Concentrates.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
I		2.2	4.8			3.7	7.0	3.7
II		2.2		6.0	2.5	1.4	[a]8.2	3.9
EXPERIMENT OF 1901.								
III		4.3	6			4.8	10.3	4.8
IV		6.6			2.3	5.6	6.6	7.9
V	21.4		2.3			4.2	23.7	4.2
VI	18.7				1.3	3.2	18.7	4.5
EXPERIMENT OF 1902.								
VII	14.6		2.3		2	2.1	16.9	4.1
VIII		3.8	4		2.5	2.7	7.8	5.2
IX	20.3		3.6	2.1	3.2		23.9	[b]5.3
X		4.3	5.5	2.5	3.7		9.8	[b]6.2

[a] Cotton-seed bran included in the roughage.
[b] Cotton-seed bran included in the concentrates.

The smallest amount of concentrates consumed per pound of gain in the 120-day feeding period where stover was fed was with Group III (4.8 pounds), but as pea hay was also substituted for cotton-seed meal in that test the result is very gratifying, and especially so as Group IV, which received stover and cotton-seed meal, consumed 7.9 pounds of concentrates for 1 pound of gain. It is noteworthy that where stover and pea hay were fed to Groups VIII and X in the experiment of 1902, the consumption of concentrates per pound of gain was considerably higher than in group VII, where silage, cotton-seed meal, and corn meal were fed. The feeding of cotton-seed meal and cotton-seed bran also increased the amount of concentrates consumed per pound of gain in Groups IX and X of that experiment. While a comparatively small amount of stover was consumed per pound of gain, the waste with this roughness was greater than with any other, as the amount fed per day averaged about 8 pounds per head, whereas the silage was eaten up perfectly clean. Then, the silage-fed cattle grew faster, the handling qualities were better, the hide soft, elastic, and flexible, and the hair glossy and oily to the touch, as compared with a coat that was inclined to be rough, dry, and shaggy with the cattle fed stover. It is quite evident that corn

stover can be utilized as a roughness to advantage on Southern farms. It should be preserved and so used, rather than neglected and permitted to waste as at the present time. There is plenty of it to feed thousands of cattle that are now but indifferently wintered, and which barely hold their own, whereas they should make a profitable gain.

THE COMPARATIVE VALUE OF SILAGE, STOVER, AND PEA HAY.

Every farmer can afford to have a silo, as silage makes a most excellent and palatable food for beef production, and one that will in the long run make an exceedingly cheap pound of gain, by reason of the small amount of concentrates required to be fed with it. It is also clear that these concentrates should be, whenever possible, cotton-seed meal and corn meal; or, if the cotton-seed meal be so expensive or so hard to procure as to render its use impracticable, chopped pea hay can be substituted for it and still very gratifying results obtained.

The following comparison shows the cost per ton, the yield per acre, and the relative feeding value of corn stover, silage, and pea hay, three important food stuffs.

Corn silage was fed for the first 30 days to Groups V and VI during the experiment of 1902, and sorghum silage for the remainder of the time. Groups VII and IX in the experiment of 1901 received sorghum silage for the first 60 days and corn silage the last 60 days. The cattle ate the silage from both sources with equal relish, and, according to observation and experimental data, made equally satisfactory gains on both kinds. Personally the writers can see no practical difference between silage from these different sources if it is properly made. They are both excellent and satisfactory for feeding beef cattle. Sorghum can often be planted as a second crop—that is, after a crop of winter cereals and legumes has been harvested—and will still mature and make a large yield of silage; and, while corn may be used in the same way, it does best if put in early on fall-plowed land. It is true that where peas are used in the corn for silage there is considerable aftermath for pasturing after the corn has been cut, but the value of it is not enough to offset the two crops that can be obtained where sorghum is used. Of course, the two-crop system is harder on the land, requiring a larger outlay for fertilizers to maintain the proper balance of the soil food, and this matter must receive careful consideration in making a comparison between the two crops.

An exhibit of the cost of silage from sorghum and corn as obtained on the University farm follows. The average yield of corn silage for the years 1900 and 1901 was 7.8 tons, at a cost of $2.19 per ton, or $17.08 per acre. This amount of silage would feed an animal for 520 days at the rate of 30 pounds per day, at a cost of 3.2 cents per day. The average yield of sorghum silage per acre for the years 1900 and 1901 was 7.2 tons, at a cost $1.78 per ton, or $12.81 per acre. This

amount would feed an animal for 480 days at the rate of 30 pounds per day, at a cost of 2.7 cents. Sufficient sorghum silage to feed 520 days would cost $14.04, or $3.04 less than the corn silage. These results are certainly in favor of sorghum silage and indicate that it could be frequently utilized to advantage should the corn crop prove a failure for any reason.

SHREDDED CORN STOVER.

Table I shows that the 15 head of cattle fed silage in the experiments of 1900 and 1901 gained 761 pounds more than those fed corn stover as a roughness. This was at the rate of 0.42 of a pound more per head per day. As much as one-third of the stover fed was frequently wasted, whereas the silage was all consumed. The increased gain made by the cattle fed silage at 4.5 cents per pound amounted to $34.24. It also appears that 4.75 pounds of shredded stover were consumed per pound of gain as against 18.75 pounds of silage; 6.02 pounds of concentrates were consumed per pound of gain when stover was fed as against 4.52 pounds when silage was fed.

When stover was fed the net cost of 1 pound of gain at high prices was 6.7 cents; at low prices, 4.97 cents. When silage was fed the net cost of 1 pound of gain at high prices was 5.82 cents; at low prices, 4.57 cents. The average slaughter test of the cattle fed stover was 55.4 per cent of the live weight; of the cattle fed silage, 56.4 per cent of the live weight. The weight of the salable meat in the carcass of the dry-fed cattle was 8,106 pounds; of the succulent-fed cattle, 8,683 pounds, a difference of 577 pounds of salable meat in favor of the succulent-fed cattle.

As already observed, an acre of silage in the experiments of 1900 and 1901 would feed a steer for 520 days at the rate of 30 pounds per day, and an acre of sorghum under the same conditions for 480 days. An acre of stover, the average yield of which on the University farm in 1900 was 1.6 tons, when fed at the rate of 8 pounds per day would furnish feed for 400 days. It would thus require 1.3 acres of land to grow enough stover to feed as long as an acre of corn silage, and 1.2 acres to feed as long as an acre of sorghum silage. The cost of producing a ton of corn silage in 1900 and 1901 was $2.19, or $17.08 per acre. The cost of producing a ton of sorghum silage under the same conditions was $1.78 per ton, or $12.81 per acre. The cost of producing a ton of stover, where two-thirds of the cost of the crop was charged up to the grain, was about $3.50 per ton, or $5.60 per acre. To produce the stover feeding equivalent of corn silage would cost $7.28, leaving a difference in favor of the stover of $9.80 per acre. To produce the stover feeding equivalent of an acre of sorghum silage would cost $6.72, a difference in favor of the stover of $6.09. These results seem at first to be so much in favor of the stover as easily to lead one astray. As the succulent food would give 0.42 of a pound more gain per head

per day than the dry food, amounting in 520 days to 218.4 pounds, which, at a sale price of 4.75 cents, would be $10.37, so that the corn silage would still show a profit over the stover of 57 cents per acre and the sorghum silage of $4.28 per acre. Because of the larger gains made by the silage-fed cattle they would be in better condition and hence command a better sale price. While it is true that these cattle were all sold at the same price, the butchers were always inclined to discriminate in favor of the silage-fed cattle because of their better condition.

Many farmers believe they can get more from harvesting the crop of corn and using the stover than from a crop of silage where the ears are put in the silo. It has already been noted that 6.02 pounds in concentrates were consumed per pound of gain when stover was fed, while only 4.52 pounds were consumed when silage was used—a difference of 1½ pounds of concentrates per pound of gain. In 520 days this would amount to 780 pounds of corn or cotton-seed meal. The corn, at 40 cents a bushel, would be worth $5.60, and the cotton-seed meal, at $20 a ton, would be worth $7.80, so that the use of silage would effect a remarkable saving in the amount and cost of the concentrates required to make 1 pound of gain through a long feeding period.

COWPEA HAY AS A SUBSTITUTE FOR COTTON-SEED MEAL.

In the experiments of 1900 from 6 to 10 pounds of cowpea hay were fed in place of 3 to 5 pounds of cotton-seed meal, with excellent results. The average gains per head per day made by Group I, fed cowpea hay in place of cotton-seed meal, was 1.8 pounds, as compared with 1.6 pounds made by Group II. Of course, Group II would probably have done better if the animals had not received any cotton-seed bran. In the experiment of 1901 Group III received from 6 to 9 pounds of pea hay in place of 2 to 3 pounds of cotton-seed meal fed Group IV. The average gain for the 120 days made by Group III was 1.3 pounds and by Group IV 1.1 pounds, further confirming the favorable results obtained with pea hay as a substitute for cotton-seed meal in the experiment of 1900. In fact, it seems reasonable to conclude that cowpea hay can be substituted for cotton-seed meal where a dry ration is fed. With a succulent ration it is not nearly so satisfactory, because the cattle can not be induced to eat enough of it. This was clearly shown in the case of Groups V and VI, where an attempt was made to substitute cowpea hay for cotton-seed meal in Group V. As a result the average daily gain for 120 days was 1.5 pounds, whereas with Group VI, which received cotton-seed meal, the average daily gain was 2.1 pounds.

If one will take the trouble to examine the tables carefully, he will find that the substitution of pea hay for cotton-seed meal effected a considerable saving in the amount of concentrates consumed per

pound of gain, and reduced the net cost of a pound of gain because of the cheapness with which it can be produced. The cattle fed pea hay did not kill out quite so well as the other groups, though the difference was not material. In one experiment last year on the University farm 7.7 acres of pea hay made an average yield of 1.9 tons when grown as a "second crop." The cost per ton placed in the barn was $5.30, and it is evident from these facts and figures that pea hay can be frequently utilized in place of high-priced corn and cotton-seed meal, and that it seems to be especially adapted for use in rations where shredded stover forms part of the roughness.

DRY AND DIGESTIBLE MATTER CONSUMED.

The smallest amount of dry matter consumed per pound of gain was by Group VI (8.2 pounds), fed silage; followed closely by Groups I and VII, the former fed stover and the latter silage. The largest consumption of dry matter per pound of gain was with Groups IX and X, fed silage and stover, respectively, with cotton-seed meal and cotton-seed bran.

TABLE IV.—*Digestible matter consumed per pound of gain.*

EXPERIMENT OF 1900.

Group.	Pounds consumed of—			Pounds consumed of—		Pounds consumed per pound of gain of—	
	Roughage.	Concentrates.	Total.	Dry matter.	Digestible matter.	Dry matter.	Digestible matter.
I	4,498.1	2,349.7	6,847.8	5,690.3	3,904.1	8.9	6.1
II	4,848.5	2,326.4	7,174.9	6,045.3	3,126.1	10.2	5.3
EXPERIMENT OF 1901.							
III	6,247.5	2,906.5	9,144.0	7,462.3	4,918.9	12.3	8.1
IV	3,448.7	4,136.3	7,585.0	5,722.8	4,235.0	10.9	8.1
V	17,276.3	3,042.0	20,318.3	7,641.0	5,354.3	10.5	7.4
VI	13,849.5	3,306.5	17,156.0	6,089.8	4,411.0	8.2	6.0
EXPERIMENT OF 1902.							
VII	14,941.3	3,611.5	18,552.8	8,066.7	5,326.6	9.1	6.0
VIII	5,493.8	3,662.0	9,155.8	7,426.3	5,026.1	10.5	7.1
IX	15,810.0	3,497.0	19,307.0	8,437.9	5,096.6	12.7	7.7
X	4,152.3	2,626.5	6,778.75	6,568.0	3,225.2	15.6	7.6

The smallest amount of digestible matter consumed per pound of gain was by Group II, fed stover, corn meal, and cotton-seed meal. While it is true that this group received some cotton-seed bran, it was only after that feed was reduced that they made any satisfactory gains. Groups VI and VII, fed silage, cotton-seed meal, and corn meal, consumed 6 pounds of digestible matter per pound of gain.

The largest amount of dry matter consumed per pound of gain was by Groups III and IV, fed stover, corn meal, and cowpea hay, and corn meal and cotton-seed meal, respectively. These statements with the previous discussion will make clear the relative value of the different rations employed.

COST OF A POUND OF GAIN.

Table V shows the cost of the food consumed and the cost of 1 pound of gain at high prices and low prices. It also indicates the cost of attendance, which, of course, was greater with the experiments of 1900 than in 1901 and 1902 owing to the larger number of animals employed. In an experiment of this kind the farmer should certainly make a portion of his profit from the value of the barnyard manure. About 96 to 98 per cent of all the plant food elements consumed are voided by beef cattle, and if the manure is given that care and attention which it merits, at least 75 per cent of its fertilizing value should easily be returned to the soil. It is on that basis that the present estimate of the net cost of 1 pound of gain has been prepared. It is worthy of note that the fluctuations in the market prices of food stuffs make a marked difference on the net cost of 1 pound of gain as well as materially changing the relative value of the food stuffs employed. It is also interesting to observe what a marked influence the fertilizing value of the food stuffs has on the net cost of 1 pound of gain as shown in the last two columns of the table.

TABLE V.—*Cost of food and cost of 1 pound of gain.*

Group	Gain in 120 days.	Cost of food.		Cost of attendance.	Value of manure.		Cost of food and care per pound gain.		Net cost of a pound of gain.	
		High price.	Low price.		Total voided.	75 per cent.	High price.	Low price.	High price.	Low price.
	Pounds.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
EXPERIMENT OF 1900.										
I	640	36.81	26.29	10.92	18.98	14.24	7.5	5.8	5.2	3.6
II	591	50.81	46.91	10.92	27.86	20.90	10.5	9.8	6.9	6.2
EXPERIMENT OF 1901.										
III	605	50.66	36.74	9.60	27.47	20.60	10.0	7.7	6.6	4.3
IV	523	48.91	39.12	9.60	30.05	22.54	11.2	9.3	6.9	5.0
V	728	52.25	38.77	9.60	23.28	17.46	8.5	6.6	6.1	4.2
VI	740	46.82	37.68	7.20	25.34	19.00	7.3	6.1	4.7	3.5
EXPERIMENT OF 1902.										
VII	886	73.44	64.80	9.60	39.81	29.86	9.4	8.4	6.0	5.0
VIII	705	71.25	59.95	9.60	42.27	31.70	11.5	9.9	7.0	5.4
IX	662	64.92	58.63	9.60	41.91	31.43	11.1	10.3	6.5	5.6
X	422	43.37	38.96	7.20	32.26	24.20	12.0	10.9	6.3	5.2

THE PRICE OF FOODSTUFFS INFLUENCES THE VALUE OF A RATION.

Considering a 120-day feeding period and high prices, it is seen that the employment of a succulent ration rendered the cost of 1 pound of gain quite reasonable, especially in the case of Groups V and VI, while the feeding of a dry ration had the reverse effect. Where high prices prevailed for food stuffs, the results are not materially changed, but the cost of producing 1 pound of gain where a dry ration was fed was so expensive as to make the profit doubtful. The importance of considering the manure as a factor in feeding beef cattle is strongly emphasized by contrasting the prices in the last four columns. For example, in the case of Group I there was a difference in the cost of 1 pound of gain of 2.3 cents in the case of high prices and 2.2 cents in the case of low prices. Many other equally interesting examples will be observed in this table. It is particularly gratifying that the net cost of 1 pound of gain should prove so reasonable when the importance of the fertilizing value of the excrements is recognized. Where high prices prevailed, the highest net cost of 1 pound of increase was 7 cents and the lowest 4.7 cents. Where low prices prevailed, the highest was 6.2 cents and the lowest 3.5 cents.

COMPARATIVE VALUE OF THE RATIONS.

With regard to the rations fed, it is clear that for long periods and cheap gains, where all things are considered at either high or low prices, that silage, cotton-seed meal, and corn meal stand very close to the top. Under certain conditions stover can also be used with gratifying results, though it is likely to give better results if used in shorter rather than in longer feeding periods. Cotton-seed meal and cotton-seed bran do not seem to be well adapted as food stuffs for making economical gains on beef cattle, either when the cotton-seed bran is fed by itself or when fed in conjunction with the cotton-seed meal in the proportion of 52 per cent of cotton-seed meal and 48 per cent of cotton-seed bran. The reader should compare Groups VII and IX and Groups VIII and X, where some striking differences are shown that must be chiefly attributed to the influence of the several concentrates employed. Cowpea hay shows up very well as a substitute for cotton-seed meal when either employed with a dry or succulent roughness. Compare Groups III and V and Groups IV and VI to get a clear understanding of its effectiveness when so employed.

THE RELATION OF NUTRITIVE RATIO TO GAIN.

In the experiment of 1901 a comparatively wide ration was used with all the different groups from the inception to the close of the experiment. It ranged with Group III, from 1:8.2 at the beginning down to 1:7 at the close; with Group IV, from 1:6 to 1:5.4, which was

the narrowest ration fed; with Group V, from 1:9.7 to 1:9; and with Group VI, from 1:7.5 to 1:6.3. Looking over the record of the different weights of these animals it was found that no uniformity existed in the rate of gain where a wide ration was commenced with and gradually narrowed down to the close of the experiment.

As the reader will recall from the table of weights, the best gains were made by Groups V and VI, which were fed considerably narrower rations than Groups III and IV. In the experiment of 1902, owing to the high price of corn meal and the comparatively cheap price of cotton-seed meal, especially when its high feeding value is considered, it was thought advisable to endeavor to feed as much cotton-seed meal as possible. Accordingly, at the beginning of the experiment 2 pounds of cotton-seed meal were fed to 1 pound of corn meal, while during the progress of the experiment this proportion was gradually reversed, until at the end 2 pounds of corn meal were being fed to 1 pound of cotton-seed meal. This gave in the case of Group VII a ration of 1:4.1 at the beginning and 1:5.5 at the close; in the case of Group VIII, 1:3.8 at the beginning and 1:4.7 at the close; in the case of Group IX, 1:3.5 and 1:4.2; in the case of Group X, 1:3.2 and 1:3.4. The gains made by Groups VII, VIII, and IX were by far the largest and most satisfactory, and the increase per head for the whole period, with a narrow ration to commence with and a wide one at the close, was greater than in the experiment of 1901. The best results in 1901 were obtained from using the narrowest of the rations employed; that is, running from 1:6 down to 1:5.4, and 1:7.5 down to 1:6.3 with Groups V and VI.

The excellent results obtained in 1902 and the gratifying gains made from the beginning to the close of the experiment make it evident that a very narrow ration can be employed at the first of the experiment, especially with cattle in a similar condition to those fed in these tests. Our experience makes it clear that in order to get the highest finish and keep up uniform gains to the end of the experiment, it is necessary to feed more corn meal through the last stages of the feeding trial than at the beginning.

In feeding cattle the object should be, especially if they are 2-year-olds and at all thin, to get as much growth and development during the first two or three months of feeding, depending on the length of the feeding period, and then to widen out the ration, reversing the proportion of cotton-seed meal and corn meal, and fatten rapidly.

RESULTS OF THE SLAUGHTER TEST.

Some interesting facts are brought out by the slaughter test (Table VI). One of these is the influence of driving cattle 2 miles and weighing them up. It is difficult to explain the small loss shown by Groups I and II unless it was due to a radical difference in the scales

on which they were weighed. It does not seem reasonable that they should lose so little when they made a poorer slaughter test than the other cattle used in the experiment, and it can not be attributed to the dry rations on which they were fed, as Groups III and IV which were fed a similar ration showed a larger loss than the silage-fed cattle of that year. Groups VII and IX, the silage-fed cattle of 1902, showed considerably more loss than the dry-fed cattle, and that makes it evident that silage-fed cattle should be finished off, where shipment to distant market is contemplated, on a comparatively high percentage of concentrates and a considerable amount of pea hay or other palatable roughness, so that the animals may stand the shipment. Of course, driving animals 2 miles and shipping them 1,200 miles would likely have a very different effect.

TABLE VI.—*Results of slaughter tests.*

EXPERIMENT OF 1900.

Group.	Weight at university farm.	Weight at stock yards.	Loss in driving 2 miles.	Weight of dressed carcass.	Loss by slaughtering.	Good meat in carcass.	Weight of liver.	Intestinal fat per head.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Per cent.*	*Pounds.*	*Pounds.*
I	3,825	3,790	35	2,007	1,659.5	53	10.1	20.8
II	3,875	3,865	10	2,018	1,731	52.2	11.3	17.8
EXPERIMENT OF 1901.								
III	4,140	4,050	90	2,241	1,694.5	55.3	9.6	19
IV	4,030	3,940	90	2,250	1,600	57.1	9.5	13
V	4,350	4,255	95	2,391	1,724	56.2	11	24
VI	3,475	3,395	80	1,954	1,290.5	57.5	12.3	37.8
EXPERIMENT OF 1902.								
VII	4,090	4,010	80	2,265	1,598.8	56.5	11.8	24.8
VIII	3,920	3,880	40	2,142	1,615.3	55.2	11.9	18.8
IX	3,885	3,800	85	2,073	1,609.8	54.6	12.3	17
X	2,785	2,735	50	1,473	1,198.5	53.9	11.1	10.1

The slaughter test with the 38 head of cattle employed in the experiments was carefully conducted. The table shows the percentage of good meat in the carcass of each of the different groups, also the weight of the liver and the pounds of intestinal fat per head. The highest per cent of good meat was made by Group VI, where silage, cotton-seed meal, and corn meal were fed. Group IV, fed stover, cotton-seed meal, and corn meal, was a close second. Then came Group VII, fed silage with the same meals, and Group III, fed stover and corn meal with pea hay as a substitute for cotton-seed

meal. Groups I and II were clearly behind all the others in the matter of slaughter test, doubtless due to the shorter feeding period, a fact which emphasizes the importance of putting a highly finished product on the market. If the animals in the experiments of 1901 and 1902 had been fed for 150 days, they would have shown considerably higher slaughter test than they did. As a matter of fact, the average cattle slaughtered in many Southern abattoirs will not dress over 50 per cent of the live weight, whereas if properly finished they should dress close to 60 per cent. On animals of the weight and size of those shown in the experiment of 1902, this would amount to a loss of 97.9 pounds per head, which, at the sale price, would mean $4.45 per head.

SILAGE-FED CATTLE KILL THE BEST.

While the percentage of good meat in any of the slaughter tests is thus considerably below what should be a fair standard, it indicates that with improved sires the standard of beef cattle could be quickly raised in the State. A gratifying result of the slaughter test is found in the fact that the silage-fed cattle showed the highest per cent of good meat, it being the prevailing though erroneous belief of the farmer and butcher that an animal fed succulent food will not "kill well." When the cattle in one of these experiments were offered for sale, the butcher proposed to discriminate against those fed silage, maintaining that they would not dress as well as the others. He was assured that if the silage-fed cattle did not dress out as well as the others he would not be expected to pay as high a price for them. The slaughter tests speak for themselves on that point and sound the death knell of a prejudiced and absurd belief. The weight of the livers was not materially influenced by the character of the ration fed, though the weight of intestinal fat showed considerable variation. It was highest, as a rule, with the silage-fed cattle. While the greater weight of the intestinal fat may be attributed in a measure to the succulent food, it is also influenced by individuality, and is not a factor of sufficient importance to have any marked influence on the investigation.

WATER CONSUMED.

Table VII shows the amount of water consumed per head per day. It was, of course, considerably less with the cattle fed succulent food, as compared with dry rations, varying from 29.8 pounds with Group V to 54.9 pounds with Group X. It is evident that an abundance of good pure water must be supplied to beef cattle at all times, no matter what the ration fed, if they are to prosper.

TABLE VII.—*Water consumed.*

EXPERIMENT OF 1900.

Group.	Water consumed.	Average per head per day.
	Pounds.	*Pounds.*
I	[a] 14,759.75	42.9
II	14,971.50	43.5
EXPERIMENT OF 1901.		
III	22,994	47.9
IV	17,695	36.9
V	14,299.25	29.8
VI	8,577.25	23.8
EXPERIMENT OF 1902.		
VII	15,561	32.4
VIII	26,093.5	54.4
IX	16,663.5	34.7
X	19,760	54.9

[a] Water for 86 days.

FINANCIAL STATEMENT.

The financial statement is presented in Table VIII, which shows the gain in value on the original cost, the increase by feeding, and the total gain from feeding. The cost of the feed and care, less 75 per cent of the manurial value, where high prices and low prices prevail, and the cash profit or loss per group under similar conditions, is also seen. The cash profit or loss per group is one of the features most interesting to the farmer. It seemed to be largest for both prices in the experiment of 1902. The silage groups (VII and IX) ran very closely together, with a profit of $28.91 and $28.24 with high prices and $37.55 and $34.53 with low prices. These groups made a greater profit than those receiving a dry ration, amounting to several dollars in some cases. In the experiment of 1901 the results were also in favor of the cattle fed a succulent ration, though there was very little difference between Groups III and V where pea hay was substituted for cotton-seed meal. In the experiment of 1900 the results were altogether in favor of Group I, but that was attributable to the disastrous effects of feeding cotton-seed bran as a roughness by itself. The profit made on the animals in any of the groups, either at high or low prices, was very gratifying, especially in the experiments of 1901 and 1902, and make it perfectly plain that the Southern farmer can afford to feed the present class of stock to advantage, as he would not only thereby save his fertilizer bills and build up his land by the proper employment of barnyard manure and a rotation of

crops, but make a very good cash profit from feeding every winter a bunch of 15, 25, or 30 cattle, such as could easily be handled on many of our farms. It is quite clear that no ration can be fed to better advantage than one composed of corn and pea silage, or sorghum and pea silage, or cotton-seed meal and corn meal.

TABLE VIII.—*Financial statement.*

Group.	Price of animals.		Gain in value.		Total gain from feeding.	Cost of feed and care, less 75 per cent manurial value.		Cash profit or loss per group.		Cash profit or loss per head per group.	
	Buying.	Selling.	Original cost.	Increase by feeding.		High price.	Low price.	High price.	Low price.	High price.	Low price.
EXPERIMENT OF 1900.											
I	$111.47	$162.56	$23.89	$27.20	$51.09	$33.49	$22.97	$17.60	$28.12	$4.40	$7.03
II	112.35	161.54	24.08	25.11	49.19	40.83	36.93	8.36	12.26	2.09	3.06
EXPERIMENT OF 1901.											
III	123.06	175.14	26.37	25.71	52.08	39.66	25.74	12.42	26.34	3.10	6.58
IV	120.68	168.77	25.86	22.23	48.09	35.97		12.12	21.91	3.03	5.47
V	124.46	182.07	26.67	30.94	57.61	44.39	[illegible]	13.22	26.70	3.30	6.67
VI	92.68	143.99	19.86	31.45	51.31	35.02	25.88	16.29	25.43	5.43	8.47
EXPERIMENT OF 1902.											
VII	112.00	194.09	40.00	42.09	82.09	53.18	44.54	28.91	37.55	7.22	9.38
VIII	112.81	186.58	40.29	33.48	73.77	49.15	37.85	24.62	35.92	6.15	8.98
IX	111.69	183.02	39.89	31.44	71.33	43.09	36.80	28.24	34.53	7.06	8.63
X	83.51	133.38	29.83	20.04	49.87	26.37	21.96	23.50	27.91	7.83	9.30

It is an advantage to feed along with it some pea hay. The value of the ration is shown by the results obtained in Groups VI and VII at both high and low prices. It is also evident that the farmer does not want to buy cotton-seed meal and cotton-seed bran, but the pure cotton-seed meal, as he can produce a roughness in pea hay that is vastly superior at much less cost. Should corn or cotton-seed meal rise to abnormal prices, cowpea hay can be profitably substituted for it to advantage. The profits will not be quite so great possibly as where cotton-seed meal is employed, but still it is a most excellent substitute, and, as it can be grown cheaply, the farmer can afford to employ it much more freely than he now does. If he can not have a silo and has an abundance of corn stover of excellent quality, he can still make satisfactory gains and a fair profit on feeding beef cattle.

SUMMARY.

In Table IX a summary of the results that are of the most general interest to the farmer are presented. By studying the table one can

easily ascertain most of the important facts concerned in the present investigations. As all the factors shown in the table have been discussed in some detail in the previous text, it will simply be passed with the advice that the factors set forth therein be given careful study and attention.

TABLE IX.—*Summary of results.*

Group.	Gain.		Food consumed per pound of gain.		Cost of food and care, less 75 per cent manurial value.		Total gain from feeding.	Good meat in carcass.	Net profit per group.	
	Total.	Average per head per day.	Dry matter.	Digestible matter.	High price.	Low price.			High price.	Low price.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*	*Dolls.*	*Dolls.*	*Per ct.*	*Dolls.*	*Dolls.*
EXPERIMENT OF 1900.										
I	640	1.8	8.9	6.1	33.49	22.97	51.09	53.0	17.60	28.12
II	591	1.6	10.2	5.3	40.83	36.93	49.19	52.2	8.36	12.26
EXPERIMENT OF 1901.										
III	605	1.3	12.3	8.1	39.66	25.74	52.08	55.3	12.42	26.34
IV	523	1.1	10.9	8.1	35.97	26.18	48.09	57.1	12.12	21.91
V	728	1.5	10.5	7.4	44.39	30.91	57.61	56.2	13.22	26.70
VI	740	2.1	8.2	6.0	35.02	25.88	51.31	57.5	16.29	25.43
EXPERIMENT OF 1902.										
VII	886	1.9	9.1	6.0	53.18	44.54	82.09	56.5	28.91	37.55
VIII	705	1.5	10.5	7.1	49.15	37.85	73.77	55.2	24.62	35.92
IX	662	1.4	12.7	7.7	43.09	36.80	71.33	54.6	28.24	34.53
X	422	1.2	15.6	7.6	26.37	21.96	49.87	53.9	23.50	27.91

CONCLUSIONS.

1. With proper attention to soil culture and rotation of crops, an abundance of cereals can be produced for supplemental grain for winter feeding.

2. The large gains sometimes made with native cattle are accounted for by the "fill-up" which these animals will make in the first several days of feeding, varying from 30 to 40 pounds per head. This can be done only with thin cattle, and it is important that the difference between "fill-up" and gain be recognized, for, as the condition of our "store" cattle improves, the "fill-up" will prove less profitable to the feeder.

3. Leaving out of consideration the preliminary feeding, very satisfactory gains can be made with native cattle, varying from 1.2 to 2.1 pounds per head per day, depending largely on the character of the ration fed. With six of the groups a gain of practically 1.5 pounds per day was made throughout the entire feeding period.

4. Groups VI and VII fed silage, cotton-seed meal, and corn meal made respective gains of 740 and 886 pounds in 120 days of feeding. The individual gain per day was 2.1 and 1.9 pounds. This ration was the most satisfactory one in point of palatability and gain in live weight and is probably better adapted for use on the average Southern farm than any other.

5. Groups I and III, fed stover, corn meal, and cowpea hay in place of cotton-seed meal, made an average gain of 1.8 and 1.3 pounds per day, indicating that pea hay can frequently be substituted to advantage for cotton-seed meal.

6. It requires long feeding periods to finish cattle properly. Several of the groups showed an average gain of 1.5 to 2 pounds per day at the end of four months' feeding, and still they were only in fair market condition, indicating that a 150-day period would have been more satisfactory.

7. Fifteen cattle fed on dry rations for 120 days made an average gain of 1.27 pounds. Fifteen cattle fed on succulent rations for the same time with the same concentrates made an average gain of 1.75 pounds. The cattle receiving a succulent ration therefore gained 761 pounds more than the dry-fed cattle.

8. Silage has a very wholesome effect on the handling qualities of cattle, making the hide soft, elastic, and flexible, and the hair glossy and oily to the touch, as compared with a coat that is inclined to be rough, dry, and shaggy with the stover-fed cattle.

9. The average results of two years' trials on the University farm show that about 7.8 tons of corn silage and 7.2 tons of sorghum silage can be obtained per acre. The cost of corn silage is $17.08 and the sorghum silage $12.81 per acre. Silage from either source is equally satisfactory as a roughness for beef cattle, though owing to the fact that sorghum silage can be grown as a "second crop" it can be produced at a little less cost than the corn silage.

10. Stover is not so satisfactory a roughness as silage. The stover-fed cattle consumed 6.02 pounds of concentrates and the silage-fed cattle 4.52 pounds of concentrates per pound of gain. A pound of gain with stover-fed cattle cost 6.7 cents at high prices and 4.97 cents at low prices, whereas with silage-fed cattle 1 pound of gain under the same conditions cost 5.82 and 4.57 cents, respectively.

11. According to the results of last year, an acre of corn silage would feed for 520 days, an acre of sorghum silage for 480 days, and an acre of stover for 400 days. An acre of corn or sorghum silage would cost much more to produce than the stover, but the added increase in live weight which the succulent-fed cattle would make more than overbalances any advantage the stover might otherwise possess.

12. When a silo is not available, corn stover should be utilized for

feeding cattle. It can be quite cheaply and easily made, and, when properly combined with cowpea hay, corn meal, and cotton-seed meal, will make a satisfactory gain.

13. Six to 10 pounds of pea hay were successfully substituted for 3 to 5 pounds of cotton-seed meal in the experiment of 1900 with good results. Further substitutes were made in the experiment of 1901 with satisfactory results. As large crops of pea hay can be cheaply produced in the South, it can frequently be utilized to advantage in place of corn meal and cotton-seed meal, especially when these concentrates are high-priced. Pea hay can not be so successfully substituted for cotton-seed meal where a succulent ration is fed as a dry ration.

14. Cotton-seed bran, fed either as a roughness by itself or when substituted for 48 per cent of cotton-seed meal and fed as a concentrate, did not prove satisfactory. The farmer can produce his own roughness for less than he can buy it, and it will always be to his interest to buy the pure cotton-seed meal.

15. The market price of food stuffs largely determines the profit from cattle feeding, and the farmer should strive to produce all the feed required at home.

16. The maximum cost of a net pound of gain where high prices prevailed was 7 cents, and the lowest 4.7 cents; where low prices were considered, 6.2 and 3.5 cents, respectively. These figures show that 1 pound of gain can be made at a very reasonable cost.

17. In feeding cattle the object should be—especially if they are 2-year-olds and at all thin—to give as much growth and development during the first two or three months of feeding, depending on the length of the feeding period, and then widen out the ration and reverse the proportions of cotton-seed meal and corn meal, and fatten rapidly.

18. The average slaughter test of the dry-fed cattle was 55.4 per cent, and of the succulent-fed cattle 56.4 per cent. The weight of good meat in the carcass of the dry-fed cattle was 8,106 pounds, and in the succulent-fed cattle 8,683 pounds—a difference of 577 pounds of salable meat in favor of the succulent-fed cattle.

19. The necessity of improving our native stock is shown by the slaughter test, which was about 55 per cent for all the groups. The average cattle slaughtered in Southern abattoirs do not dress over 50 per cent, whereas they should dress 60 per cent. With animals of the weight and size of those considered in the experiments of 1902, this would amount to a loss of 97.7 pounds per head, which, at a sale price of 4.75 cents, means a loss of $4.45 per head.

20. The gratifying result of the slaughter test is found in the fact that the silage-fed cattle made the highest per cent of good meat, it being the common belief of the farmer and the butcher that an animal fed succulent food will not "kill out" well.

THE RELATIVE VALUE OF PROTEIN IN COTTON-SEED MEAL, COWPEA HAY, AND WHEAT BRAN.

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INTRODUCTION.

Feeding the dairy cow would be a comparatively easy matter were it not for the difficulty experienced in securing a sufficient amount of protein to supply the heavy demands made on her system in the production of milk. Cheap and abundant fodder crops can be grown with comparative ease to supply the more bulky part of her ration, but the protein needed is much more difficult to provide in a desirable form at a price within the reach of the average dairyman. The abundance of cotton-seed meal in the South should offer a happy solution of the difficulty, but there are many places where freight rates make cotton-seed meal quite as expensive as in the States of the far Northwest, and then it frequently happens that the dairyman does not see his way clear to pay out a large amount of money for cotton-seed meal; for, as the old axiom puts it, "A dollar saved is a dollar made." So it is to his interest to discover, if possible, a means by which he can produce the needed protein on his own farm and thus save the heavy drain on his resources required by the purchase of cotton-seed meal or some other concentrate rich in protein.

RESULTS OF GENERAL INTEREST.

In the sections where cotton-seed meal is particularly abundant and so comparatively cheap, the present investigation may seem to have but slight application, but the reader must remember that the best results in feeding dairy cows come from a combination of concentrates rather than from the exclusive use of one, no matter how rich that may be in the elements most needed for the economic production of milk. Cotton-seed meal has now been fed long enough to establish its virtue as a feed for dairy cows, but it has also been shown that it is unwise to employ it exclusively for that purpose, as it is so rich, not only in protein, but in fat and other constituents as well, that it has a tendency to produce various nervous derangements of the cow's system, entail-

ing serious losses that can easily be avoided if the meal is employed in a more rational manner. The present investigation, therefore, has a much wider application and a more general interest than would at first seem to be the case.

These statements are not meant to disparage the use of cotton-seed meal. Far from it, for it is the most highly concentrated foodstuff produced in the United States, and it should be so completely used by the Southern farmer that there would be no surplus for sale beyond the borders of the State producing it; but, in order that it may be employed with satisfaction and with the greatest profit, its utilization must be along lines in harmony with the needs of the animal's system.

CROPS WHICH PRODUCE PROTEIN.

It now becomes important to discover what crops may be grown on the Southern farm to supply protein abundantly and in an economic manner. Fortunately, the Southern soil is adapted to the culture of several of the most important legumes known to mankind. Among these, the one that stands out preeminently is the cowpea. It is well adapted to every section of the South and can be utilized to advantage in more ways than any other legume; and, besides making a most excellent hay rich in protein, it has the power of materially improving the mechanical condition and the crop-producing power of the land—an item of the most profound concern to the Southern farmer who has been somewhat careless with regard to such matters and has sold his cotton-seed to the oil mill because of its ready cash value, though failing to return to the soil in some other form the equivalent of the plant food thus removed. As a result the fertility of much of the land has been seriously impaired, and so it is a particularly happy coincidence that the cowpea can be employed to rehabilitate the soil, produce a hay rich in protein, which combines most happily with cotton-seed meal as a feed for dairy cows, and can even be used to advantage as a substitute for wheat bran or cotton-seed meal under certain conditions.

If the present experiment is a safe criterion, the Southern dairyman can employ cotton-seed meal and cowpea hay as grain feeds for his dairy cows, and thus grow all the concentrates needed on his own farm—a matter of the gravest importance. Milk being particularly rich in nitrogenous substances makes it essential that foods rich in these elements be employed as a part of the ration, for the dairyman, in order to be successful, must have an abundance of cheap food at his command, and this applies both to roughness and concentrates. It is generally conceded that some concentrate must be bought. The smaller the amount required and the less expensive the substance employed to secure the most profitable returns, the more material the advantage becomes.

SPECIAL ADVANTAGES FOR DAIRYING.

It appears from these statements that the Southern dairyman has a phenomenal advantage in that he can so frequently utilize a home-grown ration. Wheat bran has long been considered one of the standard foods for the dairy cow. Its abundance, especially throughout the best-known dairy sections of the country and in the wheat belt as well, has hitherto made it comparatively cheap and abundant, and its fine physiological action has tended to increase its favor. As the middle South is now a large wheat-producing section and the tendency is to increase the acreage of that important cereal, wheat bran is likely to remain in favor with the dairyman if the millers will make the price such as to warrant its employment on the dairy farm. The tendency of the times is to raise the price of bran until it becomes even more expensive than cotton-seed meal, and under such circumstances it is doubtful if the dairyman can afford to employ it as extensively in the future as he has in the past if prices remain as at present. As cotton-seed meal, cowpea hay, and wheat bran are the most important protein-producing crops which can be employed to advantage in the South, the purpose of the present investigation was to compare, so far as possible, the utility of different combinations of these feeds, it being generally admitted that two concentrates must enter into the ration of the dairy cow to give the best results.

THE COWPEA AND PROTEIN PRODUCTION.

It will be interesting to learn how the cowpea ranks as a protein-producing crop, as several feeding experiments have shown that alfalfa is about equal, pound for pound, to wheat bran. In order to do so the following table was prepared, exhibiting the amount of dry matter, protein, carbohydrates, and fat, and the nutritive ratios of alfalfa, cowpeas, and red clover—legumes which can be grown, with the possible exception of alfalfa, pretty generally over the South, when compared with some standard hays.

	Dry matter.	Digestible matter—per ton.			Nutritive ratio.
		Protein.	Carbohydrates.	Fat.	
Hay from legumes—	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Alfalfa	1,832	211.6	746.6	27.6	1:3.6
Cowpea	1,786	215.8	768.0	30.2	1:3.9
Red clover	1,694	131.6	707.0	33.2	1:5.9
Hay from—					
Orchard grass	1,802	95.6	838.0	28.0	1:9.5
Timothy	1,736	57.8	874.4	28.6	1:16.2
Kentucky blue grass	1,576	95.2	746.6	39.0	1:8.9

It is noteworthy that a ton of cowpea hay is slightly richer in protein, carbohydrates, and fat than a ton of alfalfa hay, while it contains 83.2 more pounds of protein than red-clover hay, 61 pounds

more of carbohydrates, though 3 pounds less of fat. The nutritive ratio of alfalfa is 1: 3.6, of cowpea hay 1: 3.9, and of red clover 1: 5.9. Compared with standard hays, such as orchard grass, timothy, and Kentucky blue grass, any of the above legumes are seen to be infinitely richer in the food nutrients suitable for the production of milk. So it seems clear that by employing proper rotations and utilizing some one of the above legumes, probably the cowpea, owing to its being a practically sure crop and its wide adaptability, the Southern farmer can, by using cotton-seed meal, produce an abundance of protein foods for his dairy herd.

PLAN OF EXPERIMENT.

The experiment commenced on November 1, 1901, and closed March 1, 1902—a feeding period of 120 days. Twelve cows divided into three groups of 4 each were employed. The rations were fed in two equal parts and in proportion to the live weight of the animal. Aliquot samples of milk were drawn night and morning and preserved with corrosive sublimate tablets for the Babcock test. Corrections were made for the influence on specific gravity of the small amount of corrosive sublimate added as a preservative, and the solids not fat were determined by the use of the lactometer and the composite samples employed in making the fat tests. The results were satisfactory and comparatively simple as compared with the immense amount of labor involved in saving a sample of each cow's milk, cooling it down, and attempting to make a lactometer reading of it twice a day. Indeed, that would have involved so much labor as practically to cause the abandonment of that part of the experiment, though our success with the present method leads us to believe that the results would not have been any more satisfactory if the older and more laborious method had been employed.

THE RATIONS FED.

The following table (I) shows a schedule of the rations fed. Silage was the principal roughness employed, though cowpea hay was also regarded as a roughness in these experiments. To determine the relative efficiency of the protein in cotton-seed meal, cowpea hay, and wheat bran, 4 pounds of cotton-seed meal and 6 pounds of wheat bran were fed in Group I; 4 pounds of cotton-seed meal and 7 pounds of cowpea hay in Group II; and 6 pounds of wheat bran and 13 pounds of cowpea hay in Group III. Thus, in the two groups in which cotton-seed meal was fed the same amount was employed; in the two groups in which wheat bran was fed the same amount was employed; while in the two groups in which cowpea hay was fed a sufficient number of pounds were used to take the place of the protein in the wheat bran for which the pea hay was substituted in Group II, and to take the place of the 4 pounds of cotton-seed meal for which the pea

hay was substituted in Group III. The cowpea hay was fed in a finely cut condition, being run through a Blizzard shredder to which cutting and shredding bars were both attached. It was believed that by substituting an amount of cowpea hay that would supply the protein contained in the wheat bran and cotton-seed meal, respectively, that the relative efficiency of the protein in any two of the substances when combined could be determined with a fair degree of accuracy.

TABLE I.—*Schedule of rations fed.*

Group.	Name of cow.	Ration per day.	Amount.	Remarks.
			Pounds.	
I	Stophel			
	Roonan's Lady	Silage	30	
	Aggie	Cotton-seed meal	4	
	Nettte	Wheat bran	6	
II	Matilda			
	Rosy	Silage	30	
	Callie	Cotton-seed meal	4	
	Belle	Cowpea hay	70	Pea hay cut up very fine.
III	Maggie Doon			
	Stanley	Silage	30	
	Lucy	Wheat bran	6	
	Stochy	Cowpea hay	13	Pea hay to be finely cut.

THE BASIS OF SUBSTITUTION.

The following statement showing the dry matter and digestible protein, carbohydrates, and fat contained in the average analysis of cowpea hay, wheat bran, and cotton-seed meal will explain why the amounts of pea hay specified in Groups II and III were employed:

Feed.	Dry matter.	Digestible matter per 100 pounds.		
		Protein.	Carbohydrates.	Fat.
Cowpea hay	89.3	10.79	38.40	1.51
Wheat bran	88.4	12.01	41.23	2.87
Cotton-seed meal	91.8	37.01	16.52	12.58

The table indicates that 1 pound of wheat bran contains about as much protein as 1.16 pounds of cowpea hay, and 1 pound of cotton-seed meal as much protein as 3.25 pounds of cowpea hay. It was on this basis that the substitution was made. The rations employed were all found satisfactory, as the tables which follow indicate, and they were all eaten with avidity and relished by the cows, which kept in good health and condition throughout the experiment. The results obtained with pea hay would probably not have followed had it not been finely cut up. It is quite probable that if it had been ground,

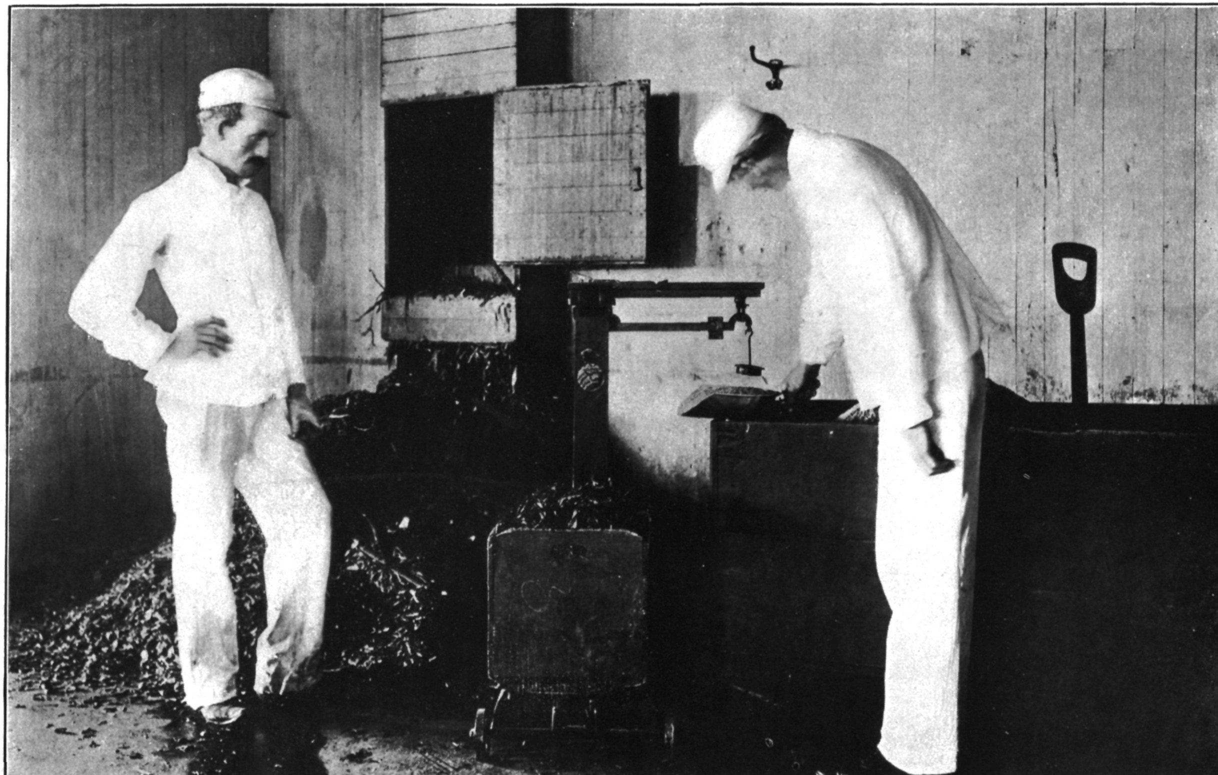
as was done in certain experiments with alfalfa, it would have been found even more satisfactory. The principal objection that could be urged against the substitution of cowpea hay for cotton-seed meal in a dairy ration would be the necessity of employing such a large amount that the cows would not be disposed to eat it. This was not a difficulty in the present investigation, though it might have been if 6 or more pounds of cotton-seed meal had been employed; but our own experience in feeding cotton-seed meal indicates that it is better to limit the amount of that concentrate to 4 or 5 pounds, and not to feed more than 6 pounds for long periods. While it is true that as much as 10 pounds of cotton-seed meal or even more might be fed to cows for a considerable period of time, in the long run it would prove injurious, and so it is much better to employ it in moderate quantities where it can be fed continuously rather than to attempt to feed it in large quantities for short periods. This is the candid opinion of men who have employed it for several years as a concentrate in feeding dairy cows.

THE CATTLE USED.

The cows employed were, with one exception, Jersey grades (Table II). The average weight of Group I was 872 pounds; Group II, 831 pounds; and Group III, 901 pounds. The animals were all in fair condition at the beginning of the experiment, but Group III was probably in considerably the best condition. The four animals in Group I gained 41 pounds in 120 days, in Group II they gained 7 pounds, and in Group III they lost 190 pounds. While the loss with Group III was quite marked, the animals closed the experiment in good condition, and so the variation in live weight could hardly be attributed solely to the foodstuffs employed.

TABLE II.—*History of cows and gain or loss in weight.*

Name of cows.	Breed.	Weight.		Gain.	Loss.
		Initial.	Final.		
Group I:		*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Staphel	Grade	827	805		22
Roonan's Lady	Jersey	782	825	43	
Aggie	Holstein	1,125	1,155	30	
Nettie	Grade	735	725		10
Group II:					
Matilda	Jersey	882	905	23	
Rosy	do	777	760		17
Callie	Grade	867	825		42
Belle	Jersey	797	840	43	
Group III:					
Maggie Doan	do	800	805	5	
Stanley	Grade	955	820		135
Lucy	do	950	905		45
Stachy	Jersey	900	885		15



PREPARING THE RATIONS.

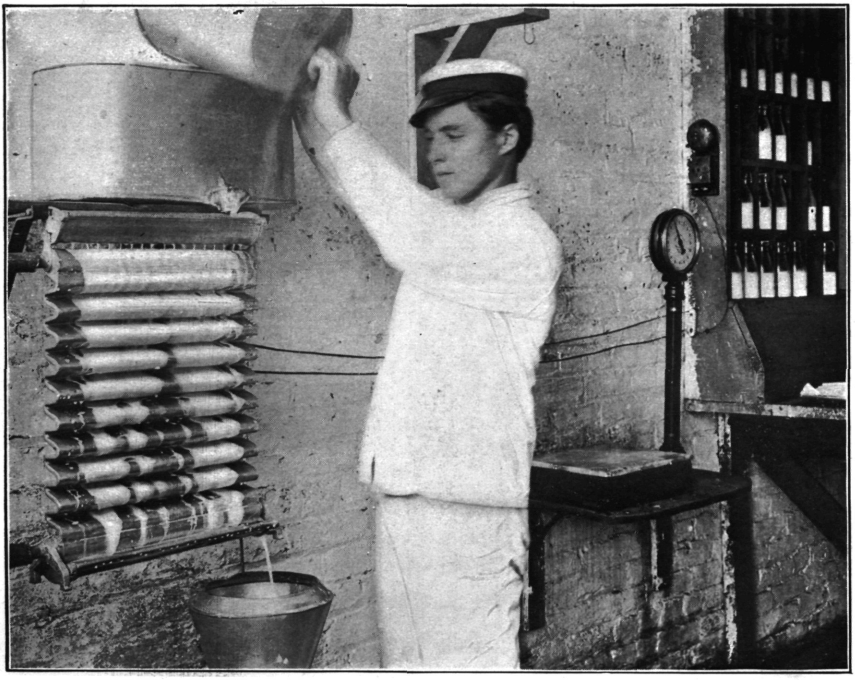


Fig. 1.—Recording the Weight and Sampling the Milk for the Fat Test and Total Solids.

Fig. 2.—Determining the Fat by the Babcock Method.

COST OF THE FOODSTUFFS AT HIGH PRICES AND LOW PRICES.

Realizing that the cost of foodstuffs has an important bearing on an experiment (Table III), the results have been figured out on the basis of what are termed high prices and low prices. For example, in the case of high prices, wheat bran is figured at $26 a ton; at low prices, $16 a ton. Cotton-seed meal is figured at $24 a ton at high price and $20 at low price; pea hay at $10 a ton high price and $6 at low price; and silage at $2.50 a ton at high price and $1.70 at low price. Near the centers of population, as in the vicinity of the larger towns and cities, where dairying is more largely developed than in the country sections, the price of bran and other foodstuffs is frequently much higher than in the country. The locality of the State also has

TABLE III.—*Cost of foodstuffs.*

Food.	High prices.	Cost per pound.	Low prices.	Cost per pound.
	Dollars.	*Cents.*	*Dollars.*	*Cents.*
Wheat bran	26.00	1.3	16.00	0.8
Cotton-seed meal	24.00	1.2	20.00	1.0
Pea hay	10.00	.5	6.00	.3
Silage	2.50	.125	1.70	.085

a marked influence on the price of foodstuffs, for the past year when bran was ranging from $26 to $27 a ton in Knoxville and other large cities it was being bought by farmers from country mills for from $14 to $16 per ton. The same is true of cotton-seed meal. A fair average price for pea hay on the farm, according to the statistics of a number of dealers, is $6 to $7. A fair average market price, according to these same men, is about $10. It does not cost $4 to put pea hay on the market, but if the farmer remembers that it takes a man and a team all day to haul a load of pea hay to market over the common type of country roads, he will find that it costs him from $2 to $3 a ton to deliver baled hay. According to actual experiments made the on University farm at Knoxville, pea hay can be produced at $4 to $5 a ton, leaving the farmer from $1 to $2 clear profit if his crop is employed at home; and, of course, it is of the utmost importance for the farmer to ascertain whether it is better for him to keep his pea hay at home and feed it, allowing himself a margin of profit over the cost of production, or to entail the labor and cost of baling and delivering the hay to the market for a very slightly increased profit, remembering that if he hopes to maintain the fertility of his farm he must replace the plant food carried off in the hay through the medium of an expensive commercial manure. If he feeds the hay intelligently, he should be able to make a further profit on it. While silage can usually be produced in Tennessee for less than $1.70 per ton, it

cost that much, owing to the severe drought of the past season, to produce it on the University farm; and, in order to have two sets of prices to compare, a sale price of $2.50 per ton has been placed on the silage somewhat arbitrarily, but it is a price that is believed fairly to represent its sale value. It is important to set forth the profits on the experiment where two sets of prices are considered, owing to the great fluctuations in the market value of foodstuffs.

FOOD CONSUMED.

Table IV shows the roughness and concentrates consumed by the different groups and the cost of the same at high prices and low prices. It is worthy of note that the increased consumption of pea hay seemed to reduce the consumption of silage in Group II, and especially in Group III, where the difference amounted, as compared with Group I, to 9,884 pounds. The table also shows the amount of roughness and concentrates consumed per gallon of milk and per pound of butter. It seems that it required almost double the amount of roughness and concentrates to produce a pound of butter that was required to produce a gallon of milk. The amount of roughness required to produce

TABLE IV.—*Food consumed.*

Group.	Roughage consumed.		Concentrates consumed.		Food consumed per gallon milk.		Food consumed per pound butter.	
	Silage.	Pea hay.	Wheat bran.	Cotton-seed meal.	Roughage.	Concentrates.	Roughage.	Concentrates.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
I	25,415	....	2,880	1,920	23.6	4.4	48.7	9.2
II	23,795	3,034	....	1,920	29.1	2.0	54.9	3.9
III	15,531	4,935	2,880	....	24.2	3.4	43.8	6.1

a gallon of milk was highest with Group II, being 29.1 pounds, while the concentrates were the lowest, being 2 pounds, or less than half of that required in Group I. Thus the substitution of 7 pounds of pea hay for 6 pounds of wheat bran in Group II, while increasing the roughness, slightly reduced the concentrates by one-half; and, as the concentrates are more expensive to buy than the pea hay, the substitution was a very desirable one. The lowest amount of roughness eaten for 1 pound of butter was 43.8 pounds by Group III, in which 13 pounds of pea hay was substituted for 4 pounds of cotton-seed meal. The highest amount of concentrates required was by Group I—9.2 pounds, or 3.2 pounds more than Group III, and 5.3 pounds more than Group II. The substitution of the pea hay, while resulting in the decreased consumption of roughness for the production of a pound of butter by Group III, and a slight increase with Group II, reduced the consumption of concentrates again very considerably.

THE PROTEIN EQUIVALENT.

In Table V the amount of each foodstuff consumed per group is shown, also the amount consumed for each gallon of milk and each pound of butter. The amount of these food stuffs has been reduced to the basis of 1,000 pounds of live weight, which will enable the reader to make a more careful comparison of the relative value of the different food stuffs. The ratio between the different concentrates consumed for the production of a gallon of milk or a pound of butter did not vary materially. Group I consumed 5 pounds of concentrates

TABLE V.—*Effect of substituting pea hay for cotton-seed meal and wheat bran.*

Food consumed.		Pounds of food—		Food consumed per 1,000 pounds live weight—	
Kind.	Pounds.	Per gallon milk.	Per pound butter.	Per gallon milk.	Per pound butter.
Group I:					
Silage	25,415	23.60	48.7	27.04	55.80
Wheat bran	2,880	2.60	5.5	4.96	6.40
Cotton-seed meal	1,920	1.78	3.68	2.04	4.20
Group II:					
Silage	23,795	25.8	48.7	29.04	58.4
Pea hay	3,034	3.29	6.20	3.96	7.44
Cotton-seed meal	1,920	2.08	3.92	2.48	4.68
Group III:					
Silage	15,531	18.4	33.3	20.96	37.92
Pea hay	4,935	5.84	10.5	6.64	11.96
Wheat bran	2,880	3.41	6.17	3.88	7.00

for the production of a gallon of milk, made up for all practical purposes of 3 pounds of wheat bran and 2 pounds of cotton-seed meal. Group II consumed 6.44 pounds of concentrates, made up for all practical purposes of 2.5 pounds of cotton-seed meal and 4 pounds of pea hay. It was therefore necessary to feed about 1¼ pounds of pea hay to take the place of 1 pound of wheat bran. Group III consumed 10.52 pounds of concentrates, made up for all practical purposes in the ratio of 4 pounds of wheat bran and 7 pounds of pea hay. It therefore required the substitution of 3 pounds or a little more of pea hay to provide the protein equivalent contained in 1 pound of cotton-seed meal. Virtually the same ratio of substitution holds in the case of both milk and butter production.

These substitutions correspond very nearly with those indicated as being necessary in the earlier part of this bulletin, so that, provided the palatability and the digestibility of the food stuffs used are equal, the source from which the protein is derived has but little effect. The practical lesson to be drawn from these results is that in making a substitution of one food for another, where the protein is the item

of chief consideration, it must always be done on the basis of the protein equivalent.

SHOULD THE FARMER GROW COWPEA HAY?

Keeping in mind the basis of substitution which the experiments seem to justify, we can now proceed to discuss intelligently what disposition the farmer should make of his pea hay, and whether he can afford to cultivate it as a concentrate for use in his dairy herd. A second crop of cowpea hay can be made at $4 to $5 a ton after a crop of winter cereals, seeded the previous autumn, has been harvested for hay or grain. Where the land was fall plowed and the peas seeded earlier, a larger yield at a less cost per ton for the cured hay should be obtained. The average yield of pea hay on the University farm the past year was about 2.5 tons per acre. It cost, therefore, to put the crop in the barn, about $12.50. The average farm price of pea hay for the State is about $6 or $7 per ton, which would make the crop worth, at the higher price, $17.50 per acre on the farm. If baled and placed on the market, it would bring about $10 per ton, or $25 per acre. A ton of bran at low prices costs about $16, or $1.50 less than the farm value of 2.5 tons of pea hay, though 2.5 tons of pea hay has twice the feeding value of the wheat bran. To purchase an amount of wheat bran equivalent in feeding value to pea hay would cost $32 at low prices, and $52 at high prices. The results are overwhelmingly in favor of the production of protein through the medium of pea hay on the farm rather than through the purchase of wheat bran. As soon as the farmer comes to realize the virtue of the pea vine and to utilize it properly, he can materially reduce the price of producing a gallon of milk or a pound of butter; and when that day comes Southern dairying will rest on a safe basis for competition with the whole world.

According to the results obtained, it would take 3 tons of pea hay to equal in feeding value a ton of cotton-seed meal. It would take 1.2 acres of land to yield that amount of hay, according to the results of the past year. It would cost about $16 to make the cowpea hay; the farm value of the crop would be about $21, and the market value $30. A ton of cotton-seed meal at low prices costs $20, and therefore 1.2 acres of land would produce pea hay equal in feeding value to a ton of cotton-seed meal at a cost of $16, leaving the farmer $4 as a margin, without utilizing the pea hay for feeding. The roots, leaves, and stubble of the peas left on the ground would supply about 40 pounds of nitrogen, which, at 15 cents a pound, would be worth $6—enough to more than compensate for the higher fertilizing value of the cotton-seed meal. It thus appears that if the farmer can grow 2.5 or more tons of pea hay per acre, he could afford to use it as a substitute for cotton-seed meal rather than purchase the latter, even

at a cost of $20 per ton; and the higher the price of cotton-seed meal the more important the production of home-grown food rich in protein becomes. It is quite clear to the practical dairyman that one of the concentrates suggested must be purchased, and, as a matter of economy, this should always be cotton-seed meal. There may be times, however, when it will pay him to buy wheat bran, even if it does cost him a good deal more in proportion, because of its fine physiological effect. But it seems perfectly clear that the Southern farmer should never purchase more than one protein food for his dairy cows.

FOOD NUTRIENTS CONSUMED.

Table VI shows the dry and digestible matter consumed in roughness and concentrates for the production of a gallon of milk and a pound of butter; also the nutritive ratios of the rations fed. It is noteworthy that these were very nearly the same, all of them being narrow, ranging from 1:4.3 with Group II to 1:4.8 with Group III. Observe that the smallest amount of dry matter and digestible matter was consumed for both purposes by Group I, and the largest by Group II. While there was considerable variation shown in the amount of dry matter consumed by these two groups, very slight differences appear with regard to the digestible matter in the case of all groups. In the case of dry matter required for a gallon of milk, the amounts consumed by Groups I, II, and III were, respectively, 6.2, 6.3, and 7.2 pounds—an extreme difference between Groups I and III of 1 pound per gallon of milk.

With regard to the digestible matter consumed for the production of 1 pound of butter, the difference was even less marked, the amounts consumed being 12.7, 12.3, and 13.1 pounds, or an extreme difference of 0.4 of a pound. The larger consumption of dry matter by Group III was not a matter of so much importance, as this did not involve the outlay of any considerable amount of money. It is quite evident that the larger consumption of dry matter for the production of 1 gallon of milk and 1 pound of butter by Group III was due to the 13 pounds of pea hay substituted for the 4 pounds of cotton-seed meal.

TABLE VI.—*Digestible matter.*

Group.	Pounds consumed of—		Pounds consumed of—		Pounds consumed for each gallon of milk.		Pounds consumed for each pound of butter.		Nutritive ratio.
	Roughage.	Concentrates.	Dry matter.	Digestible matter.	Dry matter.	Digestible matter.	Dry matter.	Digestible matter.	
I	25,415	4,800	9,827.48	6,662.24	9.1	6.2	18.8	12.7	1:4.5
II	26,839	1,920	9,611.98	6,049.19	10.4	6.5	19.6	12.3	1:4.3
III	20,464	2,880	10,353.65	6,116.70	12.2	7.2	22.2	13.1	1:4.8

INFLUENCE OF FEED ON THE COMPOSITION OF MILK.

Table VII shows the influence of the feed on the production of milk, fat, and solids. The largest amount of milk was produced by Group I (9,134 pounds), and the smallest by Group III (7,176 pounds). These differences were probably as much due to individuality in the animals as to the feeds employed. The difference in the yield of milk was somewhat compensated for by the higher fat test of the milk of Groups II and III, so that the fat and butter yield was more nearly equal than one would have anticipated. The highest lactometer test was shown by the milk of Group III, being 34. The highest yield of solids not fat was made by Group I, as was also the highest yield of total solids. The maximum yield of butter per 100 pounds of milk was made by Group III, with 6.4 pounds; Group II followed with 6.2 pounds, and Group I with 5.7 pounds. Figured out on the basis of 100 pounds, the solids not fat and the total solids were more nearly equal than might have been expected, being with Groups I, II, and III, 13.4, 14, and 14.3, respectively. It appears that all the foods were satisfactory in maintaining a good flow of milk, a high fat content, and a high per cent of total solids, and the variations shown are not definite enough to attribute the results to any material influence of the respective feeds.

TABLE VII.—*Influence of feed on the production of milk, fat, and solids.*

Group.	Milk produced.	Fat test.	Fat produced.	Butter produced.	Lactometer test.	Solids not fat.	Total solids.	Pounds of butter per 100 pounds of milk.	Pounds of solids not fat per 100 pounds of milk.	Pounds of total solids per 100 pounds of milk.
	Gals.	*Per ct.*	*Pounds.*	*Pounds.*	*Per ct.*	*Pounds.*	*Pounds.*			
I	9,134	4.9	447.59	522.18	33.1	778.22	1,225.81	5.7	8.4	13.4
II	7,833	5.3	415.14	484.33	33.6	678.57	1,093.71	6.2	8.6	14.0
III	7,176	5.5	394.68	460.46	34.0	635.20	1,029.88	6.4	8.8	14.3

INFLUENCE OF PROTEIN CONSUMPTION ON THE YIELD OF MILK AND BUTTER.

Table VIII shows the total amount of protein consumed by the three groups. The largest amount was consumed by Group I, 1,294.20 pounds, while Group III consumed much less, or 1,024.11 pounds. The protein consumed per 1,000 pounds of live weight was highest with Group II, 377.9 pounds, and smallest with Group III, 284 pounds—a difference of 93.9 pounds of protein per 1,000 pounds of live weight. Keeping in mind the two sets of prices already referred to, it appears that Group II consumed the largest amount of protein

per 1,000 pounds of live weight, and made the cheapest gallon of milk and the cheapest pound of butter at low prices, being 5.2 and 9.9 cents, respectively. Group III, which consumed the smallest amount of protein produced a gallon of milk at a cost of 6 cents and a pound of butter at a cost of 10.9 cents, while Group I produced a gallon of milk at a cost of 5.9 cents and a pound of butter at 12.2 cents. Thus, while Group III produced a gallon of milk at practically the same cost as Group I with a much smaller consumption of protein, it produced a pound of butter at a considerably smaller cost.

TABLE VIII.—*Relation of protein consumption to cost of milk and butter.*

Group.	Protein consumed.	Protein consumed per 1,000 pounds, live weight.	Cost of a gallon of milk at high price of feed.	Cost of a pound of butter at high price of feed.	Cost of a gallon of milk at low price of feed.	Cost of a pound of butter at low price of feed.
	Pounds.	*Pounds.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
I	1,294.20	373.0	8.5	17.6	5.9	12.2
II	1,256.06	377.9	7.3	13.9	5.2	9.9
III	1,024.11	284.9	9.6	17.4	6.0	10.9

Where high prices are considered, the results favor Group II and a high consumption of protein; that is, the ration which contained the cotton-seed meal and cowpea hay. The cost of a gallon of milk was 7.8 cents, and the cost of a pound of butter 14 cents, with Group II. Where high prices are considered, Group I, fed bran and cotton-seed meal, fared best and had a material advantage over Group III, fed wheat bran and cowpea hay as a substitute for cotton-seed meal.

FERTILIZER VALUE OF THE FOOD.

In summing up any feeding experiment with dairy cows (Table IX) the fertilizing value of the food will have a definite influence on the results, and under no circumstances should its influence on the experiment be overlooked. It will also indicate to a certain extent what food stuffs one could afford to purchase where their utility for the mere production of milk and butter are practically the same. The fertilizing value of the food—that is, the nitrogen, phosphoric acid, and potash contained in the food stuff—is presented in the following table:

TABLE IX.—*Fertilizing value of the food.*

Group.	Food consumed		Nitrogen.	Phosphoric acid.	Potash.	Value of manure.	
	Roughage.	Concentrates.				Total voided.	60 per cent.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Dollars.*	*Dollars.*
I	25,415	4,800	278.41	166.47	157.09	45.67	34.25
II	26,839	1,920	256.14	97.23	149.93	40.21	30.16
III	20,464	2,880	216.60	125.97	176.36	37.53	28.16

The total value of all the fertilizing elements and the value of 60 per cent of the elements voided is likewise presented. The value of the excrements is estimated on the basis of 15 cents per pound for available nitrogen, 4.5 cents for available phosphoric acid, and 5 cents for available potash. The total amount voided is estimated on the basis of 80 per cent of the mineral elements supplied in the ration, and while with the best of care and attention practically all of these elements would be conserved and utilized as plant food, even under indifferent management, 60 per cent should be saved and so utilized.

The total value of the excrements voided was the largest with Group I, doubtless due to the cotton-seed meal fed, being $45.67; it was smallest with Group III, being $37.53—a difference of $8.14. This disparity was due to the substitution of cowpea hay for cotton-seed meal, and might lead many to suppose that one could afford to use cotton-seed meal under any circumstances in preference to cowpea hay on account of its increased fertilizing value. The cowpea has a wonderful capacity for improving the mechanical condition of the soil, as the fallen leaves, roots, etc., which are left on the ground will supply anywhere from 25 to 40 pounds of nitrogen per acre, which offsets, if it does not clearly overbalance, the added fertilizing value of the mineral constituents in the cotton-seed meal. According to these results the total manurial value of the excrements voided would be $123.41; if only 60 per cent were saved it would be $92.57. The fertilizing value of the food stuffs is a material factor in determining the profit on feeding dairy cows, and should always be so considered.

FINANCIAL STATEMENT.

Table X presents the financial side of the experiment when both high prices and low prices are considered. The cost of attendance was figured at $14.40 per group, and the animals were credited with 60 per cent of the value of the excrements voided. It is perfectly clear that the cost of the care and attention given a cow will be offset by the value of the manure where it is properly utilized.

On the basis of comparison shown, the net cost of a gallon of milk at high prices varied from 5.6 cents with Group II to 8 cents with Group III. Here as elsewhere the cheapest gallon of milk was made by the combination of the two protein foods—cotton-seed meal and cowpea hay. The net cost of a pound of butter was also lowest with Group II, when high prices are considered, being 10.7 cents, and highest with Group III, being 14.5 cents. The combination of wheat bran and cowpea hay as a substitute for cotton-seed meal was here unsatisfactory in every instance. On the other hand, when low prices for food stuffs are considered—that is, where cowpea hay and silage are grown on the farm and fed at their farm value—the conditions with regard to Groups I and III were reversed. Group II still

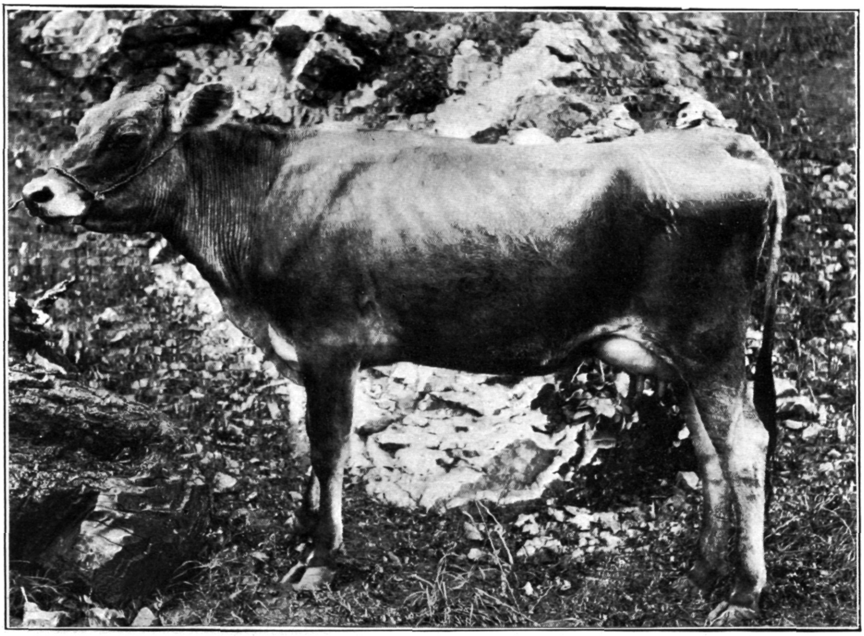


FIG. 1.—LADY TIPPEN, A PROMISING JERSEY HEIFER.

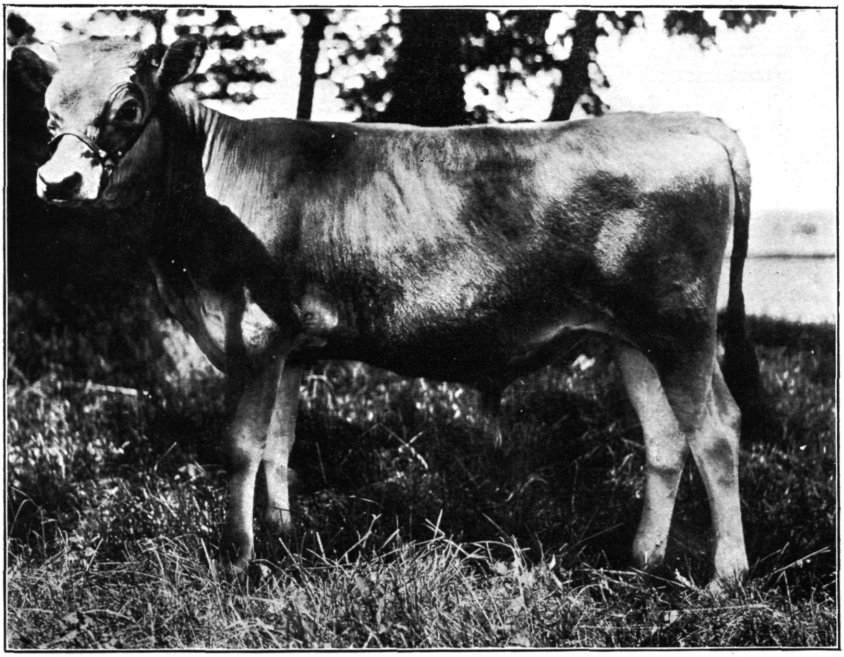


FIG. 2.—IUKA'S TORMENTOR, A BULL CALF, SHOWING FINE QUALITY. RAISED ON SKIMMED MILK.

FIG. 1.—SKIMMED MILK CALVES.

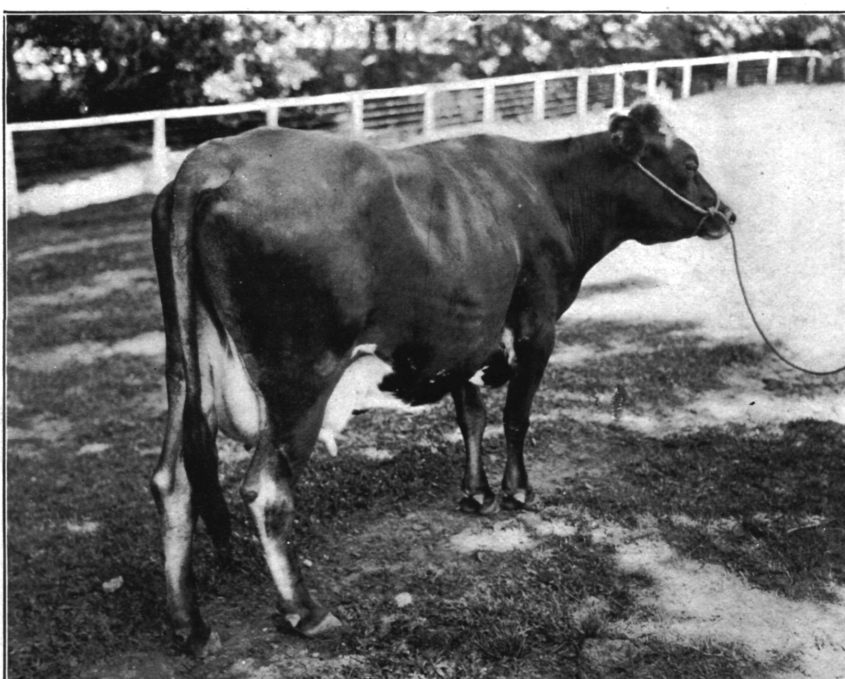


FIG. 2.—ROLILDA 2D, A FINE TYPE OF JERSEY COW, SHOWING A WELL-DEVELOPED UDDER.

stands first, however, making a gallon of milk at a net cost of 3.5 cents and a pound of butter for 6.7 cents. Group I now comes second with the cost of a gallon of milk being 4 cents and a pound of butter 8.4 cents.

TABLE X.—*Financial statement.*

Group.	Cost of food.		Attendance.	Value of 60 per cent of manure voided.	Net cost gallon milk at high price of food.	Net cost pound butter at high price of food.	Net cost gallon milk at low price of food.	Net cost pound butter at low price of food.
	High prices.	Low prices.						
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
I	92.24	63.84	14.40	34.25	6.7	13.8	4.0	8.4
II	67.95	48.52	14.40	30.16	5.6	10.7	3.5	6.7
III	81.52	51.04	14.40	28.16	8.0	14.5	4.4	7.9

With regard to the cost of butter production the results are reversed, Group III standing first with a cost of 7.9 cents, and Group I last with a cost of 8.4 cents. The results throughout favor the combination of cowpea hay and cotton-seed meal—two rich protein-containing foods—whether high prices or low prices are considered for milk and butter making. They indicate also that at low prices cowpea hay can be substituted for cotton-seed meal with satisfactory results, whereas this can not be done when high prices prevail. The results of the experiment indicate that it would be better for the farmer to purchase cotton-seed meal at $20 to $24 per ton rather than buy wheat bran at prices ranging from $16 to $26 per ton.

The figures presented in this table show that any one of the rations suggested may be fed with advantage and profit on the average farm in the South, and that the profit to be derived from the use of each will be influenced very considerably by the price of the food stuffs, freight rates, distance from market, etc. The cheapness with which milk and butter can be produced is a subject for congratulation, for, as milk ordinarily retails at 25 to 30 cents a gallon in the State, the farmer who uses a silo and feeds his cattle in a rational manner can certainly make a handsome profit over the cost of production; and the same is true of butter, which retails at 20 to 30 cents a pound, depending on its quality. There is a demand for much more 25 and 30 cent butter than is now available, and, even at the high prices prevailing for food stuffs the past year, the dairyman could have made a clear profit of from 10 to 15 cents a pound if he had good average dairy cows in his herd. The dairy business can be made an unquestionable success in the middle South, as all the local conditions favor the development of giant enterprises of this character, but the business must be conducted intelligently and the greatest care exercised in the selection, breeding, and management of the herd, and

also in the choice and combination of food stuffs in order to secure the largest returns.

PROFIT OR LOSS.

Table XI gives a summary of the results, showing the value of the milk and butter produced at high prices and at low prices. It seems that with such cows as were used in these tests, the profit on the milk at low prices for food stuffs would have amounted, in the case of Group I to $201.95, and with Group III to $157.78. In the case of butter the results were reversed, Group II showing the greatest profit, $49.21; Group III, second, with $42.22, and Group I last. The profit on the butter would be greater because the skimmed milk would amount to very considerable, as it has been shown in experiments conducted on the station farm to be worth from 25 to 30 cents per 100 pounds for feeding to hogs, and would also be valuable for the sustenance of calves intended for the dairy.

The profit at high prices for foodstuffs showed no material difference with regard to the relative standing of the groups so far as milk production is concerned, except, of course, that the profit was considerably less. When butter is considered, the results are strikingly different, and the ration most profitable was the one rich in protein, consisting of a combination of cotton-seed meal with cowpea hay substituted for wheat bran. The profits on the butter with Group II, fed cotton-seed meal and pea hay as substitutes for wheat bran, were $29.68; $11.74 with Group III, fed wheat bran and cowpea hay as a substitute for cotton-seed meal; and $11.99 with Group I, fed on wheat bran and cotton-seed meal. The profits on the butter with these two groups were thus about the same. Pea hay has made a remarkably fine showing in these results and seems to be an excellent substitute for either wheat bran or cotton-seed meal, though it can better supply the place of wheat bran than cotton-seed meal. It is an exceedingly palatable substitute for bran, and is greedily eaten by dairy cattle. As it can be produced cheaply and in abundance, and improve the soil of the farm at the same time, the results are particularly gratifying to Southern farmers, as they can produce a home-grown ration of the highest excellence for dairy production.

TABLE XI.—*Profit on milk and butter.*

Groups.	Cost of feed.		Value of milk at 25 cents per gallon.	Value of butter at 20 cents per pound.	Profit at high prices.		Profit at low prices.	
	High prices.	Low prices.			Milk.	Butter.	Milk.	Butter.
I	$92.24	$63.84	$265.79	$104.23	[a] $173.55	$11.99	$201.95	$40.39
II	67.95	48.52	227.94	97.73	159.99	29.68	179.42	49.21
III	81.52	51.04	208.82	93.26	127.30	11.74	157.78	42.22

[a] The cost of labor is not considered in the profits above, as the manurial value of the foodstuffs more than offsets that item.

SUMMARY OF RESULTS.

1. Only about one-half as much food is consumed in the production of 1 gallon of milk as is eaten to produce 1 pound of butter.

2. The smallest amount of roughness consumed in the production of 1 pound of butter was 43.8 pounds with Group III, in which 13 pounds of pea hay was substituted for 4 pounds of cotton-seed meal.

3. The highest amount of concentrates consumed was by Group I, 9.2 pounds, or 3.2 pounds more than in Group III, and 5.3 pounds more than in Group II. The substitution of pea hay for wheat bran in Group II and for cotton-seed meal in Group III thus resulted in materially reducing the consumption of the concentrates.

4. It seems clear that 1.25 pounds of chopped pea hay can take the place of 1 pound of wheat bran, and about 3 pounds of chopped pea hay the place of 1 pound of cotton-seed meal. The substitution of the pea hay for either of the concentrates mentioned must be made on the basis of the protein equivalent.

5. Some 2.5 tons of pea hay can be produced on an acre of average farm lands at a cost of $12.50. The farm price of the crop is about $7 per ton. The farm sale price would thus be about $17.50. Baled and placed on the market, it would bring about $25.

6. The cost of a ton of bran at low prices is $16, or $1.50 less than the farm sale price of 2.5 tons of pea hay, though 2.5 tons of pea hay have twice the feeding value of wheat bran. It is certainly to the interest of the farmer to produce at least half of the protein needed for his cows through the medium of pea hay rather than by the purchase of wheat bran.

7. According to the yield of pea hay obtained at this station, it would require 1.2 acres of land to produce the protein equivalent contained in 1 ton of cotton-seed meal. The cost of producing the hay would be about $16, its farm sale value would be about $21, and its market value some $30.

8. In addition, the pea crop would store in the soil about 40 pounds of atmospheric nitrogen worth $6, and, as they would cost the farmer $16, it would be better for him to grow and utilize the peas in place of cotton-seed meal, unless he could buy the meal for $20 or less. It would be to his interest, however, as he would need to purchase some concentrate, to buy cotton-seed meal at $20 to $24 a ton rather than wheat bran.

9. While the substitution of 7 pounds of pea hay for 6 pounds of wheat bran and 13 pounds of pea hay for 4 pounds of cotton-seed meal, on the basis of the protein equivalent, was thus very satisfactory, it is evident that if it were desired to substitute pea hay for 6 or 8 pounds of cotton-seed meal, it would be difficult, if not impossible, to get the cattle to consume all the pea hay satisfactorily.

10. The results indicate that at moderate prices and at even high

prices for food stuffs pea hay can be substituted to advantage for wheat bran; that at high prices for cowpea hay and wheat bran the latter would have the advantage; at low prices cowpea hay could be fed to advantage with bran as a substitute for cotton-seed meal.

11. The net cost of 1 gallon of milk at high prices varied from 6.1 cents with Group II to 8.9 cents with Group III. Here as elsewhere the cheapest gallon of milk was made with a combination of the two protein foods—cotton-seed meal and cowpea hay.

12. While cotton-seed meal is the most highly concentrated food stuff known and should be so completely utilized by the Southern farmer that there would be none for sale beyond its borders, it frequently happens to be a great advantage to the farmer if he can utilize some protein-producing crop in its place, such as the cowpea.

13. In round numbers the amount and ratio of meals consumed for the production of 1 gallon of milk was as follows: Group I, 3 pounds of wheat bran and 2 pounds of cotton-seed meal; Group II, 2.5 pounds of cotton-seed meal and 4 pounds of pea hay; Group III, 4 pounds of wheat bran and 7 pounds of pea hay. The same ratio holds in the case of butter, though the amount of concentrates consumed was considerably more.

14. Providing the palatability and the digestibility of the food stuffs used are equal, the source from which the protein is derived has but little effect if the substitution of one food for another is made on the basis of the protein equivalent.

15. The amount of dry matter consumed for the production of 1 gallon of milk was 6.2, 6.5, and 7.2 pounds with Groups I, II, and III, respectively. The digestible matter consumed for 1 pound of butter was practically the same, being 12.7, 12.3, and 13.1 pounds with Groups I, II, and III.

16. All the rations fed were satisfactory in maintaining a good flow of milk—having a high fat content and a high percentage of total solids.

17. Group II consumed the largest amount of protein for 1,000 pounds of live weight, and made the cheapest gallon of milk (5.2 cents) and the cheapest pound of butter (9.9 cents). Group III, which consumed the smallest amount of dry matter, produced 1 gallon of milk at a cost of 6 cents, and 1 pound of butter at a cost of 10.9 cents. Group I produced 1 gallon of milk at a cost of 5.9 cents, and 1 pound of butter at a cost of 12.2 cents.

18. As milk retails at from 25 to 30 cents a gallon, and butter is in demand at 25 to 30 cents a pound, it is evident that the Southern farmer who owns a herd of good cows can make large profits from the dairy business.

DISTRIBUTION AND MAGNITUDE OF THE POULTRY AND EGG INDUSTRY.

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POULTRY AN ESSENTIAL PART OF FARM STOCK.

Chickens form an essential part of the stock upon many farms. The Twelfth Census shows that there were 5,739,657 farms in the United States in 1900, and it is safe to say that those which did not have chickens among the stock were very few indeed. The census also shows that there were 250,681,593 fowls (chickens, turkeys, geese, and ducks) in the United States. This gives an average of 42 to every farm.

The statistics of this paper, so far as they relate to the poultry of the United States, are principally from the bulletins issued by the Census Office for the several States and Territories. Poultry not on farms is omitted from the census bulletins, hence that on farms only is here considered. The raising of poultry in the villages of the country is a matter of no small consequence, and the totals would no doubt greatly augment the farm totals.

It will be observed that the enumeration of fowls was for the year 1900, having been made in June of that year, while the production of poultry and eggs—that which was sold or reserved for breeding—was for the calendar year 1899. Poultry is sold and eggs are produced during every month of the year, and the calendar year was probably much easier to handle than a fiscal year would have been, as the farmer usually closes his accounts in December, and upon these accounts the census enumerators based their reports; but it would not be a fair showing to the industry to enumerate the fowls on January 1, for the reason that during the calendar year millions of fowls would be hatched and grown into table poultry and consumed, and so never be counted. For purposes of comparison there is practically no difference in this matter between 1899 and 1900.

One of the things that will first attract the attention of one who reviews these statistics is the apparent large decrease in the number of poultry in 1900 from the number in 1890. This decrease is only apparent, not real; for the census enumerators in 1900 were instructed not to take account of fowls under three months old. In 1890 all

fowls, whatever their ages, were enumerated. These facts should be kept in mind in making any comparisons in numbers between the census years. That there was an enormous increase during the decade may be known from the very large increase in the number of eggs produced. For instance, the tables show that in 1890 there were 285,609,440 fowls in the United States and 250,681,593 in 1900—a decrease of about 35,000,000. The production of eggs, however, amounted to 1,293,818,144 dozen in 1899. This was an increase of 474,095,228 dozen over 1889, and is evidence of a very large increase in the number of fowls.

POULTRY STOCK AND POULTRY PRODUCTS.

The value of all fowls on farms in 1900 was $85,794,996. It is difficult to estimate how much should be deducted from this sum to represent the fowls under the age of three months, but evidently the amount should be considerable. Whatever remains after such a deduction represents quite accurately the poultry stock, that is, that which is kept for breeding and laying. Let us assume that this reduced amount is $70,000,000, which certainly is not too low. Now, we have 250,681,593 fowls, worth $70,000,000, producing for market in one year poultry worth $136,891,877 and eggs worth $144,286,370—a total value of $281,178,247. The investment has yielded an income of 400 per cent! This is not a matter of much astonishment to one who is familiar with poultry raising and has reckoned on the possibilities of the hen. In seeking for the causes of this startling situation one must not overlook the great amount of work done by the mechanical incubator, which is not only as fully successful as the hen, but does its work on a very large scale. The use of the incubator has made it the duty of the hen to devote her whole time to the production of eggs.

In 33 of the States and Territories the value of the eggs exceeds the value of the poultry product, while in the remaining 19 the reverse is true. The table following shows that in the New England States especially, the eggs greatly outvalue the poultry product:

Value of poultry and egg products in 1899.

State or Territory.	Poultry.	Eggs.	State or Territory.	Poultry.	Eggs.
Alabama	$2,263,346	$1,825,978	Georgia	$2,481,610	$1,615,538
Alaska	179	360	Hawaii	61,546	45,257
Arizona	114,884	163,486	Idaho	282,468	465,504
Arkansas	2,179,634	2,328,509	Illinois	11,307,599	8,942,401
California	2,492,067	3,864,679	Indiana	8,172,993	7,441,944
Colorado	587,536	852,978	Indian Territory	647,844	625,418
Connecticut	984,207	1,523,319	Iowa	9,491,819	10,016,707
Delaware	596,391	488,401	Kansas	6,491,183	7,237,111
District of Columbia	5,480	6,492	Kentucky	4,970,063	3,460,607
Florida	574,703	553,524	Louisiana	1,425,116	1,281,713

Value of poultry and egg products in 1899—Continued.

State or Territory.	Poultry.	Eggs.
Maine	$955,468	$2,038,225
Maryland	2,077,490	1,572,682
Massachusetts	1,407,681	2,571,341
Michigan	4,551,945	6,104,462
Minnesota	2,927,717	4,437,148
Mississippi	2,387,484	1,871,765
Missouri	9,525,252	8,315,371
Montana	398,487	631,143
Nebraska	3,499,044	4,068,002
Nevada	71,175	122,522
New Hampshire	610,696	1,213,703
New Jersey	2,265,816	1,938,304
New Mexico	90,152	157,175
New York	6,161,429	8,630,062
North Carolina	2,689,970	1,810,116
North Dakota	594,751	782,790
Ohio	8,847,009	10,280,769
Oklahoma	$1,302,460	$1,284,414
Oregon	826,687	1,162,071
Pennsylvania	7,151,243	9,080,725
Rhode Island	398,790	656,845
South Carolina	1,539,755	925,966
South Dakota	1,020,382	1,727,392
Tennessee	4,282,740	3,115,335
Texas	5,311,362	4,672,187
Utah	262,503	424,628
Vermont	689,109	959,965
Virginia	3,744,654	2,836,899
Washington	848,291	1,259,225
West Virginia	1,843,752	1,877,675
Wisconsin	3,398,427	4,854,020
Wyoming	79,488	163,517
Total	136,891,877	144,286,370

Production of eggs in 1879, 1889, and 1899, and price per dozen in 1899.

[Compiled from census reports.]

State or Territory.	Production of eggs in—			Price per dozen, 1899.
	1879	1889	1899	
	Dozens.	*Dozens.*	*Dozens.*	*Cents.*
Alabama	6,761,646	10,823,526	18,778,960	9.7
Alaska				43
Arizona	72,534	204,174	819,507	20
Arkansas	6,610,050	13,371,909	25,694,860	9
California	5,771,323	13,679,423	24,443,540	15.8
Colorado	520,820	2,685,109	5,704,290	15
Connecticut	5,209,061	5,637,590	7,959,430	19
Delaware	1,427,087	2,218,754	3,571,870	13.7
District of Columbia	35,836	48,430	42,580	12.9
Florida	1,024,106	2,788,991	4,214,186	13.1
Georgia	7,126,058	11,522,788	15,505,330	15.4
Hawaii			155,710	29
Idaho	268,731	737,813	2,879,590	16.1
Illinois	35,978,297	60,351,065	86,402,670	10.3
Indiana	28,823,819	48,621,660	70,782,200	10.5
Indian Territory			6,949,640	9
Iowa	32,253,933	69,448,339	99,621,920	10
Kansas	17,432,286	42,584,975	73,190,590	9.9
Kentucky	15,812,205	24,691,437	35,337,340	9.8
Louisiana	3,392,246	5,933,700	12,820,290	10
Maine	7,059,876	9,384,252	13,304,151	15.2
Maryland	4,984,776	8,718,593	12,511,450	12.6
Massachusetts	6,571,553	8,931,398	12,928,630	19.9
Michigan	20,762,171	34,309,633	54,318,410	11.2
Minnesota	8,234,161	20,354,498	43,208,130	10.2
Mississippi	6,364,410	11,393,498	18,942,070	9.8
Missouri	28,352,032	53,147,418	85,203,290	9.8
Montana	208,794	834,166	3,002,890	20.6
Nebraska	7,166,090	23,300,684	41,132,140	9.9

Production of eggs in 1879, 1889, and 1899, and price per dozen in 1899—Continued.

State or Territory.	Production of eggs in— 1879	1889	1899	Price per dozen, 1899.
	Dozens.	*Dozens.*	*Dozens.*	*Cents.*
Nevada	120,471	170,725	589,495	20.8
New Hampshire	3,347,211	5,049,150	7,005,180	17.3
New Jersey	6,686,142	8,031,571	11,942,550	16.3
New Mexico	238,858	279,664	839,890	18.7
New York	31,958,739	45,807,106	62,096,690	13.8
North Carolina	7,455,132	11,755,635	17,704,020	10.2
North Dakota[a]	1,012,613	3,552,664	7,438,400	10.5
Ohio	43,092,291	70,162,240	91,766,630	11.1
Oklahoma	....	989,625	13,724,900	9.3
Oregon	1,654,738	4,453,933	7,709,970	15
Pennsylvania	34,377,889	50,049,915	67,038,180	13.5
Rhode Island	1,564,934	2,020,714	3,217,310	20.4
South Carolina	3,416,846	5,702,141	9,007,700	12.8
South Dakota	....	8,777,993	17,349,750	9.9
Tennessee	16,347,482	23,172,313	31,807,990	9.8
Texas	11,486,566	32,466,433	58,040,810	7.7
Utah	826,237	1,131,071	3,387,340	12.5
Vermont	3,050,131	4,515,130	6,271,880	13.7
Virginia	8,950,629	13,557,571	25,550,460	11.1
Washington	501,448	2,710,520	7,473,790	16.9
West Virginia	6,741,893	9,919,974	17,242,400	10.9
Wisconsin	15,826,025	29,390,784	46,249,580	10.5
Wyoming	30,740	332,221	937,570	17
Total	456,910,960	819,722,916	1,293,818,144	11.1

[a] Includes Dakota before division into North Dakota and South Dakota.

In the production of eggs Iowa leads, with 99,621,920 dozens, worth $10,016,707. Ohio comes second as to amount, with 91,766,630 dozens, worth $10,280,769. It will be observed that, although Iowa had about 8,000,000 dozens of eggs more than Ohio, the value of the product of the latter State was considerably higher. Illinois takes third place for eggs, with 86,402,670 dozens, worth $8,942,401, and Missouri comes next, with 85,203,290 dozens, worth $8,315,371.

The table showing the production and price per dozen of eggs, by States, for the years 1879, 1889, and 1899 contains much that is of interest to one who may be inclined to compare different States as to production and price. The highest price realized for eggs per dozen, leaving Alaska and Hawaii out of consideration, is credited to Nevada, the average there being 20.8 cents. Montana was a very close competitor, at the average price of 20.6 cents. Washington comes next, with an average of 16.9 cents. California fourth, with 15.8 cents as an average, and Oregon is fifth, with 15 cents as an average. The lowest price obtained for eggs was the average of 7.7 cents, by Texas. That State disposed of 58,040,810 dozens at this average price.

The average farm price of the 1,293,818,144 dozens of eggs produced in the United States in 1899 was 11.15 cents. The number of eggs per

capita for the same year was 203, and the value of the eggs per capita was $1.89.

Another statement that will, no doubt, come as a surprise to most people is that the egg product of 1899 was valued at a higher figure than the combined gold and silver product of the United States during any year since 1850, except for the one year of 1900, when the precious metals exceeded the eggs by $9,418,125. The same statement is true of the poultry product, if we except the years of 1899 and 1900, when the excesses of gold and silver combined over eggs were, respectively, $4,967,123 and $16,812,618. The surprise occasioned by these figures is still further heightened when we become aware that the poultry and eggs together in 1900 were worth more than either the gold or the silver production of the world for any year since the beginning of records, in 1493, excepting the two years of 1898 and 1899, when the poultry products fell below to the extent of $5,701,453 and $25,990,553, respectively.

Comparisons of this kind are always interesting, and they are also profitable in that they give an adequate conception of the immensity of the poultry industry of the country. Pursuing the comparisons further, therefore, we find that the poultry and eggs of 1899 outvalued the total exports of animals and animal products during all the years down to and including 1900. In 1901 the total exports of animals and animal products amounted to $295,786,642, thus exceeding the poultry and eggs by $14,608,395. These exports, it should be stated, include animals, hoofs, horns, bones, glue, bristles, grease, hair, and hair manufactures, hides and skins, hide cuttings, boots and shoes, leather of all kinds, dairy products, sausage casings, and wool and wool manufactures.

The value of all products of animal origin in 1899 (wool, mohair and goat hair, milk, butter, cheese, eggs, poultry, honey, wax, animals sold, and animals slaughtered) amounted to $1,718,990,221. Poultry and eggs, which formed 16.3 per cent of this great sum, were outvalued by two of these products only—dairy products (milk, butter, and cheese) and animals sold. The item of wool, which is ever a matter of concern in the commercial world, and which is so important as sometimes to become the shibboleth of a political campaign, was worth but $45,723,739, being $91,168,138 less than the value of the poultry sold and $98,563,232 less than the worth of the eggs produced, and less than one-third of the value of these two combined. Animals slaughtered on the farms were worth but $52,981,433 more than the poultry product and $45,586,940 more than the eggs produced; but the animals which were slaughtered were worth $91,304,937 less than the poultry and eggs taken together. (See fig. 17.)

The poultry and egg product of 1899 exceeded in value the wheat crop of twenty-eight States and Territories, as follows: Alabama,

Arizona, Arkansas, Connecticut, District of Columbia, Florida, Georgia, Illinois, Indian Territory, Iowa, Louisiana, Maine, Massachusetts, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Texas, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming. It was worth more than the corn crop of the following: Arizona, California, Colorado, Connecticut, District of Columbia, Idaho, Maine, Massachu-

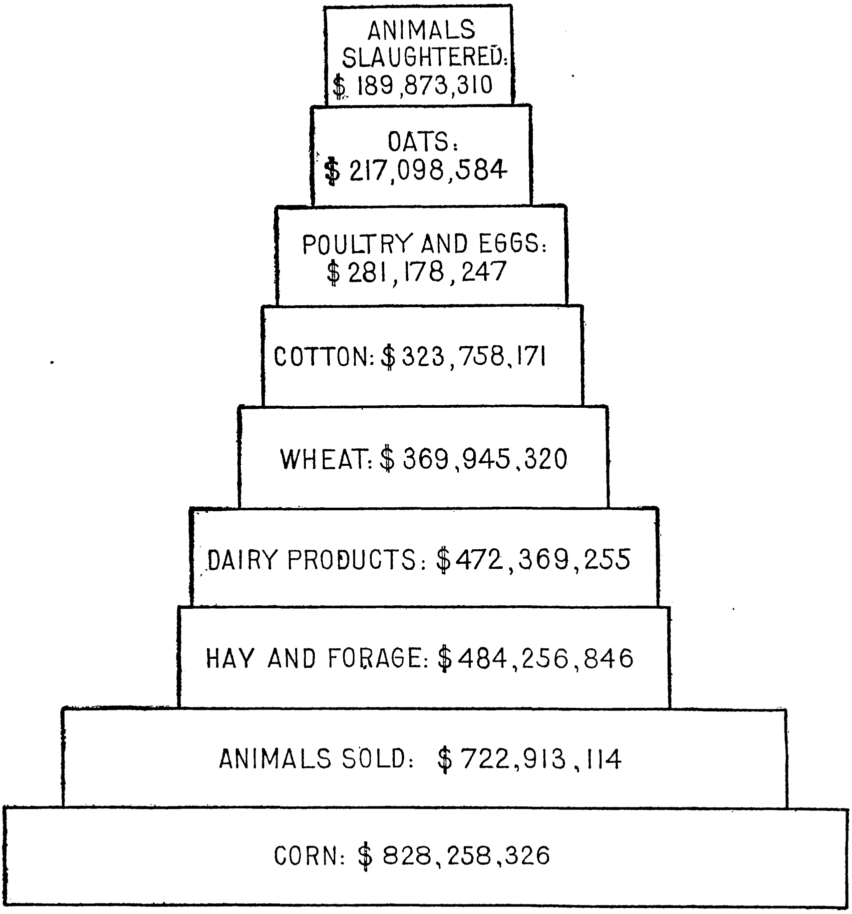

FIG. 17.—Relative position of poultry and eggs among leading farm products in 1899.

setts, Montana, Nevada, New Hampshire, New York, North Dakota, Oregon, Rhode Island, Utah, Vermont, Washington, and Wyoming.

The table shows that there were produced on farms, in 1899, 1,293,818,144 dozens of eggs. This amounts to 43,127,272 crates of 30 dozens each. An ordinary refrigerator car, which has an average length of about 42.5 feet, holds 400 crates. All this means, then, that a train of these cars sufficient to carry the product of 1899 would be

868 miles long, or long enough to reach from Chicago to Washington and have several miles of cars to spare.

TURKEYS, GEESE, AND DUCKS.

While the very large majority of the fowls on farms were chickens, there were enough turkeys, geese, and ducks to demand attention. In 1900 there were 6,599,367 turkeys, 5,676,863 geese, and 4,807,355 ducks, not including any under 3 months old. Texas leads in the number of turkeys, with 648,671; Illinois is second, with 446,020, and Iowa is a close third, with 424,306. Kentucky leads in the number of geese, having reported 541,576; Missouri reported 428,307; Texas, 415,709; Arkansas, 378,475; Mississippi, 357,963. As to ducks, Iowa takes the lead, with 487,752; then comes in the order given Illinois, with 382,857; Missouri, with 278,140; Texas, with 234,664, and Indiana, with 230,432. The values of these different kinds of poultry are not given separately in the census reports.

It is very seldom that the eggs of the turkey and the goose are found in the markets. Duck eggs are frequently on sale in limited quantities, but they are not so desirable as the hen eggs, although they are larger. This is because of their peculiarly unpleasant flavor, which is said to be due to the character of the food of the duck. Practically all the eggs, therefore, that find their way to market are those of the hen. Turkeys, geese, and ducks are not kept primarily for egg production, but the first for meat and the other two for meat and feathers.

Number of fowls, by States and Territories, in 1890 and 1900, and value of same in 1900.

[Compiled from census reports.]

State or Territory.	1890.				
	Chickens.	Turkeys.	Geese.	Ducks.	Total.
Alabama	6,252,044	177,681	381,226	102,850	6,913,801
Alaska					
Arizona	57,224	2,744	157	1,685	61,810
Arkansas	6,264,427	118,816	469,083	195,779	7,048,105
California	3,504,251	287,799	37,659	157,514	3,987,223
Colorado	710,942	20,872	1,096	12,105	745,015
Connecticut	1,075,044	30,176	5,100	31,484	1,141,804
Delaware	900,212	70,578	10,525	50,046	1,031,361
District of Columbia	10,543	215	84	291	11,133
Florida	919,601	34,426	37,502	9,491	1,001,020
Georgia	7,357,934	148,797	291,676	105,537	7,903,944
Hawaii					
Idaho	231,547	6,433	1,447	7,296	246,723
Illinois	21,463,525	1,043,947	725,904	735,660	23,969,036
Indiana	12,307,903	505,111	434,778	348,001	13,595,793
Indian Territory					
Iowa	20,201,706	940,849	261,695	547,023	21,951,273
Kansas	15,843,345	530,397	117,916	485,097	16,976,755

Number of fowls, by States and Territories, in 1890 and 1900, etc.—Continued.

State or Territory.	1890.				
	Chickens.	Turkeys.	Geese.	Ducks.	Total.
Kentucky	12,740,559	672,106	967,417	370,401	14,750,483
Louisiana	2,246,907	74,680	149,312	67,112	2,538,011
Maine	1,411,185	15,259	7,270	26,947	1,460,661
Maryland	3,430,859	278,522	91,238	232,519	4,033,138
Massachusetts	1,623,605	5,805	8,379	70,593	1,708,382
Michigan	5,852,690	185,847	72,898	98,789	6,210,224
Minnesota	4,448,831	151,459	69,224	74,697	4,744,211
Mississippi	5,631,784	194,398	474,688	63,727	6,364,597
Missouri	22,785,848	928,751	849,230	627,959	25,191,788
Montana	233,660	5,077	722	4,193	243,652
Nebraska	7,395,368	218,636	69,839	275,180	7,959,023
Nevada	62,167	4,193	525	2,718	69,603
New Hampshire	934,322	10,207	2,795	17,031	964,355
New Jersey	2,990,698	162,270	20,367	113,668	3,287,003
New Mexico	60,596	928	216	1,104	62,844
New York	8,421,667	402,642	80,403	301,419	9,206,131
North Carolina	7,507,593	197,420	375,991	169,409	8,250,413
North Dakota	804,388	33,928	9,593	11,592	859,501
Ohio	13,659,359	521,171	277,225	409,698	14,867,453
Oklahoma	388,427	5,931	725	4,484	399,567
Oregon	1,180,765	43,555	21,389	32,325	1,278,034
Pennsylvania	10,381,781	535,828	106,538	357,238	11,381,385
Porto Rico	....	....	....	....	....
Rhode Island	482,370	11,656	16,805	13,706	524,537
South Carolina	3,873,798	149,126	121,525	47,099	4,191,548
South Dakota	2,292,866	60,163	22,465	48,632	2,424,126
Tennessee	12,062,139	430,333	778,128	361,984	13,632,584
Texas	11,523,717	535,916	528,149	391,086	12,978,868
Utah	279,983	9,220	1,451	5,655	296,309
Vermont	789,278	72,164	10,838	13,047	885,327
Virginia	6,576,260	477,414	216,175	299,142	7,568,991
Washington	779,972	17,187	5,847	14,122	817,128
West Virginia	3,197,447	214,756	176,723	133,942	3,722,868
Wisconsin	5,646,294	206,230	130,082	91,206	6,073,812
Wyoming	73,694	2,441	155	1,797	78,087
Total	258,871,125	10,754,060	8,440,175	7,544,080	285,609,440

State or Territory.	1900.					
	Chickens.	Turkeys.	Geese.	Ducks.	Total.	Value.
Alabama	4,737,606	129,326	243,657	75,947	5,186,536	$1,409,269
Alaska	176	....	....	....	176	166
Arizona	165,200	6,043	840	2,439	174,522	80,798
Arkansas	5,393,157	140,661	378,475	180,583	6,092,876	1,540,006
California	3,947,200	158,356	28,419	62,293	4,196,268	1,877,489
Colorado	968,761	30,781	2,576	15,002	1,017,120	393,219
Connecticut	1,073,026	7,717	3,530	14,100	1,098,373	644,050
Delaware	628,866	19,045	6,438	10,933	665,282	357,475
District of Columbia	8,004	46	16	227	8,293	3,108
Florida	1,107,816	32,869	36,658	6,877	1,184,220	394,557
Georgia	4,549,144	103,416	208,997	64,895	4,926,452	1,458,055
Hawaii	31,888	4,672	75	21,508	58,143	38,237
Idaho	516,412	10,211	3,850	9,536	540,009	203,127

Number of fowls, by States and Territories, in 1890 and 1900, etc.—Continued.

State or Territory.	1900					
	Chickens.	Turkeys.	Geese.	Ducks.	Total.	Value.
Illinois	16,600,728	446,020	307,657	382,857	17,737,262	$6,415,C33
Indiana	11,103,006	345,379	271,004	230,432	11,949,821	4,222,409
Indian Territory	1,960,505	92,509	77,216	88,069	2,218,299	515,384
Iowa	18,907,673	424,306	223,612	487,752	20,043,343	6,535,464
Kansas	11,966,843	275,330	97,768	216,244	12,556,185	4,356,997
Kentucky	6,849,079	279,749	541,576	185,064	7,855,468	2,723,221
Louisiana	3,890,563	115,921	169,936	123,059	4,299,479	1,057,889
Maine	1,564,853	6,437	4,566	9,708	1,585,564	756,153
Maryland	2,113,544	101,782	33,389	56,930	2,305,645	1,158,020
Massachusetts	1,625,269	3,018	6,389	46,017	1,680,693	1,018,119
Michigan	8,033,531	191,863	73,267	106,399	8,405,060	2,685,829
Minnesota	7,730,940	193,143	90,975	127,635	8,142,693	2,274,649
Mississippi	5,194,856	189,698	357,963	95,668	5,838,185	1,655,319
Missouri	14,903,601	466,665	428,307	278,140	16,076,713	5,720,359
Montana	531,774	12,637	2,629	9,639	556,679	296,806
Nebraska	7,417,837	118,892	74,007	201,503	7,812,239	2,374,930
Nevada	100,661	3,618	880	2,379	107,538	55,826
New Hampshire	870,461	2,386	1,289	3,803	877,939	467,104
New Jersey	1,993,594	32,378	10,518	40,024	2,076,514	1,300,853
New Mexico	156,853	3,805	830	1,527	163,015	62,419
New York	8,964,736	190,879	45,933	150,864	9,352,412	4,310,755
North Carolina	3,871,858	120,737	284,424	102,942	4,379,961	1,434,158
North Dakota	1,409,205	39,073	17,206	23,816	1,489,300	477,358
Ohio	14,269,525	362,924	179,665	206,238	15,018,352	5,085,921
Oklahoma	2,527,353	86,450	12,934	71,562	2,698,299	900,743
Oregon	1,290,818	36,031	26,580	19,774	1,373,203	582,524
Pennsylvania	10,553,106	259,824	60,780	171,271	11,044,981	4,483,486
Porto Rico	....	....	....	....	365,499	....
Rhode Island	500,618	4,604	6,335	8,957	520,514	305,047
South Carolina	2,664,784	120,140	83,543	39,852	2,908,319	889,953
South Dakota	3,028,700	53,740	33,334	62,511	3,178,285	856,966
Tennessee	6,184,210	193,397	391,698	202,432	6,971,737	2,275,864
Texas	13,562,302	648,671	415,709	234,664	14,861,346	3,595,243
Utah	534,842	10,649	2,759	8,503	556,753	186,922
Vermont	806,451	22,689	5,187	8,836	843,163	421,195
Virginia	4,590,311	207,675	125,495	117,989	5,041,470	1,886,768
Washington	1,196,639	29,155	64,488	66,433	1,356,715	614,838
West Virginia	2,759,585	105,265	129,948	58,273	3,053,071	963,805
Wisconsin	8,097,399	155,121	102,224	92,800	8,447,544	2,410,714
Wyoming	142,136	3,664	1,312	2,452	149,564	60,397
Total	233,598,005	6,599,367	5,676,863	4,807,358	250,681,593	85,794,996

ANNUAL CONSUMPTION OF EGGS.

It would be interesting to know how many eggs are consumed annually in the United States, but this is a matter which can not be arrived at definitely. There would, of course, be no difficulty in getting the difference between the total production and the exports, but the number reserved for hatching is an uncertain quantity and very large.

Mr. J. Dixon Avery, of the Chicago Butter and Egg Board, quite

recently stated that the people of the United States consume 90 per cent of all the eggs produced. A part of a paper which he read at the time of this estimate is quoted in order to give some insight into the consumption of eggs in cities, especially Chicago and New York:

Of course, no one can get the exact amount of eggs consumed daily any month or any week of the year, but I have succeeded in getting together figures that I think are fairly convincing.

We find that the receipts and consumption of eggs in New York City aggregated last year 2,372,500 cases. Assuming the population of Greater New York to be 3,000,000, we find that each person in New York consumes $\frac{78}{100}$ of an egg daily. Admitting that we consume as many eggs per capita here in Chicago as they do in New York City, and also granting that we have 2,000,000 population here, we find the average daily consumption in Chicago to be 4,333 cases of eggs.

We all know the daily consumption in Chicago to be 4,333 cases. We believe that there is no day in the year that the consumption in Chicago is less than 2,000 cases. We also believe that during the early spring season, or during March and April, the consumption of eggs would be about double the average, or 8,666 cases daily; therefore, we have the two extremes before us—namely, from 2,000 cases to 8,666. I estimate further that there are about four months in the year—namely, May, June, September, and October—that the consumption is about the average per day for the twelve months, and if it is also conceded that the consumption during two of the spring months is double the average, then the daily consumption for the other six months of the year would average from 2,000 to 4,000 cases.

I find the receipts of eggs in Chicago from March 1, 1901, to March 1, 1902, to be 1,888,190 cases, and allowing that the daily consumption is as stated, we consume in this city 1,581,545 cases yearly. Deducting this from the receipts as shown above shows that we ship to various cities, East and West, North and South, 306,645 cases yearly.

Again, referring to the production of eggs in the United States, would say I find by the census report for 1899 that there were produced on the farms and ranches of the United States 43,127,306 cases of eggs, and also find by the same report that the production ten years before, or in 1889, was only 25,324,073 cases. Therefore, the increase in the ten years was 15,803,233 cases, or a little over 58 per cent for the ten years, or something over 5½ per cent for each year. Now, in order to get the production of eggs upon the farms and ranches last year, or two years later than the time the census was taken, we must add 11 per cent to the census report, which would make last year's production upon the farms and ranches 47,871,309 cases, and it seems to me that the production outside of the farms and ranches—namely, in the hamlets, villages, towns, and cities—is at least 2½ per cent of the production upon the farms and ranches. If we add 2½ per cent to these figures, we would have a grand total of 49,068,091 cases as the production for last year.

IMPORTS AND EXPORTS OF EGGS AND POULTRY.

The imports of eggs form an insignificant part of the sum total of our commerce. For the fiscal year ended June 30, 1900, the value of eggs imported was only $8,741; for the fiscal year of 1902, however, a considerable increase is shown, the value being $37,432 for 384,070 dozens. This was at the rate of 9.7 cents per dozen at port of shipment. Records of imports are available since 1862, and these show that there have been years when the value of imported eggs has been quite large. This is especially true of the years 1880 to 1891, inclusive.

The exports of eggs in 1900 (fiscal year) were the largest in the history of the industry, amounting to 5,920,727 dozens, valued at $984,081. When the quantity exported is compared with the 1,293,-818,144 dozens produced in the census year of 1899, one is impressed with the insignificance of the exports. Such a comparison emphasizes in the most forcible manner the immensity and the consequent value of the home market.

The very large majority of the fowls of this country are found in comparatively small numbers on a very large number of farms, where they gather their own subsistence and receive practically no care. The consequence of this is that the eggs are produced at little cost. The development of this industry to an extent incredibly larger than it is at the present time is among the easy possibilities. When this is done there will be produced a surplus, which must find an outside market.

A table of imports and exports accompanies this article, giving the statistics for the fiscal years ended June 30, 1862 to 1902, inclusive.

As to the imports and exports of poultry, accurate data are not available. From 1850 to 1883, inclusive, poultry is included in the reports among other animals. From 1884 to 1902, inclusive, the returns appear under the title of "poultry and game." So the figures given in the following table are for poultry and game combined. There does not appear to be any satisfactory method by which one may estimate how much of these exports should be credited to poultry.

Intensive farming is coming more and more into favor as the country becomes more densely populated and as a larger number of farmers adopt scientific methods of practice. The tendency of this is toward the production of more poultry and eggs, and the matter of a foreign market for the surplus will soon come up for settlement.

Value of imports and exports of poultry and game, 1884 to 1902.

Fiscal year.	Imports of poultry and game.	Exports of poultry and game.	Fiscal year.	Imports of poultry and game.	Exports of poultry and game.
1884	$590,791	$69,618	1894	$274,789	$71,880
1885	280,123	97,012	1895	233,416	69,287
1886	338,840	87,315	1896	226,500	80,399
1887	305,402	68,687	1897	211,122	140,853
1888	358,204	67,962	1898	239,681	335,914
1889	392,712	95,968	1899	265,032	505,540
1890	413,491	120,725	1900	311,638	753,399
1891	357,927	34,340	1901	....	1,070,190
1892	307,752	37,989	1902	....	856,801
1893	525,269	61,094			

Quantity and value of imports and exports of eggs, 1862 to 1902.

Fiscal year.	Imports of eggs.		Exports of eggs.	
	Dozens.	*Value.*	*Dozens.*	*Value.*
1862	....	$90,163	....	....
1863	....	55,068	....	....
1864	....	59,980	....	....
1865	....	121,252	....	$51,218
1866	....	187,494	72,114	22,458
1867	....	....	31,642	11,329
1868	....	....	19,604	5,865
1869	....	74,589	....	4,055
1870	....	13,270	814	322
1871	....	287,949	5,017	1,428
1872	4,905,423	649,894	5,148	1,048
1873	5,065,577	683,850	15,683	4,169
1874	5,601,175	747,866	23,749	5,239
1875	4,351,810	600,472	34,119	8,743
1876	4,903,771	630,393	29,633	8,300
1877	5,048,271	[a] 617,622	32,591	8,429
1878	6,053,649	[b] 726,037	94,265	14,880
1879	6,022,506	646,735	91,740	14,250
1880	7,773,492	901,932	85,885	14,148
1881	9,578,071	1,206,067	80,146	13,776
1882	11,929,355	1,808,505	146,776	28,262
1883	15,279,065	2,677,604	360,023	75,080
1884	16,487,204	2,677,360	295,484	62,750
1885	16,098,450	2,476,672	240,768	51,832
1886	16,092,583	2,173,454	252,202	46,105
1887	13,936,054	1,960,396	372,772	60,686
1888	15,642,861	2,312,478	419,701	66,724
1889	15,918,809	2,418,976	548,750	75,936
1890	15,062,796	2,074,912	380,884	58,675
1891	8,926,043	1,185,595	363,116	64,259
1892	4,188,492	522,240	183,063	32,374
1893	3,318,011	392,973	143,489	33,207
1894	1,791,430	199,536	163,061	27,497
1895	2,705,502	324,136	151,007	25,317
1896	947,132	88,682	328,485	48,339
1897	580,681	47,760	1,300,183	180 954
1898	166,319	8,078	2,754,810	448,370
1899	225,180	21,300	3,693,611	641,385
1900	135,038	8,741	5,920,727	984,081
1901	126,520	10,515	3,692,875	676,232
1902	384,070	37,432	2,717,990	528,679

[a] Does not include $2,529, value of condensed eggs.
[b] Does not include $2,213, value of condensed eggs.

An examination of the exports of animals and animal products for the year 1901 shows that the United Kingdom took $181,397,723 worth out of the total of $295,786,642. Previous years show about the same ratio. It is also learned from British reports that the consumption per capita of imported eggs has gradually been on the increase for many years. In looking for an outlet for the surplus eggs

and poultry, it is, therefore, quite natural to consider the possibilities of the United Kingdom for consuming them.

It is an easy matter to show the quantity of eggs imported into the United Kingdom, the quantity reshipped, and the number per capita of the imports, but there are no data at hand to show the extent of English production and consumption. Tables relative to imports are given herewith; they are compiled from the report of the Board of Agriculture for Great Britain for the year 1901.

Values of poultry and game and eggs imported into the United Kingdom, 1881 to 1901.

Year.	Value of poultry and game.	Value of eggs.	Year.	Value of poultry and game.	Value of eggs.
1881		$11,301,911	1892	$2,839,206	$18,467,035
1882		11,607 882	1893	2,817,504	18,860,836
1883		13,295,546	1894	2,340,232	18,426,170
1884		14,163,914	1895	2,945,011	19,482,770
1885		14,264,865	1896	3,432,309	20,364,628
1886	$1,712,463	14,035,293	1897	3,556,073	21,202,401
1887	1,995,722	15,016,467	1898	3,102,355	21,690,560
1888	1,963,813	15,004,232	1899	3,821,633	24,548,582
1889	2,302,794	15,220,417	1900	4,916,961	26,308,396
1890	2,422,821	16,686,384	1901	4,772,766	26,745,194
1891	2,223,888	17,059,623			

The eggs exported from the United Kingdom in 1900 was a small factor in the commerce of that country. The number of dozens was 154,400, and they were valued at $22,220. This was at the rate of 14.4 cents per dozen.

Imports of eggs into the United Kingdom in 1901, by countries.

Country.	Eggs.	Country.	Eggs.
	Dozens.		*Dozens.*
Argentina	2,417	Sweden	166,167
Belgium	25,756,417	Turkey	11,417
Denmark	30,194,167	United States	3,426,167
Egypt	4,264,083	British possessions:	
France	18,061,742	Canada	703,500
Germany	29,719,833	Channel Islands	1,667
Holland	1,246,833	Gibraltar	36,083
Italy	1,000	Malta	9,000
Morocco	4,184,750	Newfoundland	1,333
Norway	8,583	New Zealand	333
Portugal	817,667	Total	170,710,000
Russia	44,921,083		
Spain	926,500		

Imports of eggs into the United Kingdom in 1901 were 170,710,000 dozens, valued at $26,745,174, or about 15.6 cents per dozen. The table giving countries from which imports were made shows that Russia was the principal country of supply, with 539,053,000, or 44,921,083 dozens. Belgium, Denmark, and Germany supplied about equal amounts. The imports from the United States amounted to the small sum of 3,426,167 dozens. Belgium, Denmark, Egypt, France, Germany, Morocco, and Russia each sold more eggs to the United Kingdom than did the United States; but it must not be forgotten that it was the demand of the home market that kept the exports of our own country at such a low figure.

It is interesting to note that the per capita consumption of eggs imported into the United Kingdom in 1901 was 49. In 1881 the number consumed per capita was 22, and since that year the number has gradually increased till it reached 49 in 1900 and 1901.

THE POULTRY AND EGG INDUSTRY IN THE STATES AND TERRITORIES.

A review of the poultry and egg industry in the several States and Territories follows. Let it be stated here that the figures for 1880 do not include the spring hatching of chickens for any State or Territory.

ALABAMA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					3,016,699
1890	6,252,044	177,681	381,226	102,850	6,913,801
1900	4,737,606	129,326	243,657	75,947	[a] 5,186,536

[a] Does not include fowls under three months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	6,761,646
1889	10,823,526
1899	18,778,960

The total value of the poultry products in 1899 was $4,089,324, of which $2,263,346 was for poultry disposed of by home consumption or sale and $1,825,978 was for eggs. We find that the total value of poultry on farms June 1, 1900, was $1,409,269; so that it appears that the surplus disposed of exceeded by $854,077 in value the poultry kept on the farm. Add to this the value of eggs produced, and we have the sum of $2,680,055 resulting in one year from poultry valued at $1,409,269.

All animal products of the farm (wool, mohair, milk, butter, cheese, eggs, poultry, honey, wax, animals sold, and animals slaughtered) amounted in value to $18,196,689, 22.5 per cent of which represented poultry and eggs. Milk, butter, and cheese, with a value of $6,610,967, and animals slaughtered, valued at $5,189,443, were the only products that exceeded poultry and eggs in value.

The average returns per farm were $11.83 for poultry and $9.54 for eggs. The average value of eggs per dozen was 9.7 cents.

The following table shows the position of poultry products in relation to other principal farm crops:

Cotton	$37,004,598
Corn	17,082,751
Dairy products (milk, butter, and cheese)	6,610,967
Animals slaughtered	5,189,443
Cotton seed	5,065,079
Eggs and poultry	4,089,324
Miscellaneous vegetables	2,613,718
Forest products	2,494,452
Animals sold	1,958,640

ARIZONA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					22,550
1890	57,224	2,744	157	1,685	61,810
1900	165,200	6,043	840	2,439	[a] 174,522

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	72,534
1889	204,174
1899	819,507

Arizona shows a very large increase in the number of poultry over the census figures of 1890, the latest number being 174,522. This would be very much increased if the chickens under three months had been included. The value of the poultry on farms in 1900 was $80,798, while the value of poultry products in 1899 was $278,370, of which $163,486 represent the eggs and $114,884 represent the poultry.

The value of all animal products was $4,522,801, poultry products forming 6.1 per cent of this. In this western country, where live stock is the leading industry, it is not surprising that the poultry industry falls to sixth place among animal products, but of the vegetable products hay and forage alone exceed the poultry products, as will be seen by the statement below.

The production of eggs in 1899 was 819,507 dozens, while in 1889 the number was 204,174 dozens, showing an increase of 615,333 dozens. The average price per dozen of the eggs produced in 1899 was a small fraction less than 20 cents.

A comparison of the poultry industry with some other farm products is shown below.

Animals sold	$2,908,745
Hay and forage	1,361,422
Dairy products (milk, butter, and cheese)	540,700
Wool	424,158
Animals slaughtered	296,013
Poultry products	278,370
Wheat	276,639
Barley	223,985

ARKANSAS.

Number of poultry on farms, 1880, 1890, and 1900.

Years.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					2,711,562
1890	6,264,427	118,816	469,083	195,779	7,048,105
1900	5,393,157	140,661	378,475	180,583	[a]6,092,876

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	6,610,050
1889	13,371,909
1899	25,694,860

The value of all poultry in Arkansas in 1900 was $1,540,006, and the number, exclusive of that under 3 months old, was 6,092,876. The value of the poultry products in 1899 was $4,508,143, of which sum $2,328,509 was for eggs and $2,179,634 was for poultry.

The value of all animal products was $20,377,278, and poultry products constituted 22.1 per cent of this sum. Dairy products, with a value of $6,912,459, and animals slaughtered, valued at $4,927,481, were the only animal products which were worth more than the poultry and eggs.

The number of eggs produced in 1899 was 25,694,860 dozens, while in 1889 the number was but 13,371,909, showing an increase for the census decade of 12,322,951 dozens. The average price per dozen was 9 cents. The census figures show that the average return per farm for poultry products was $28.73—$14.84 for the eggs and $13.89 for the poultry.

In order to show the relative position of poultry products, the values of some of the leading farm products are given below:

Cotton	$24,671,445
Corn	17,572,170
Dairy products (milk, butter, and cheese)	6,912,459
Animals slaughtered	4,927,481
Poultry and eggs	4,508,143
Animals sold	3,752,843
Cotton seed	3,382,368
Forest products	2,468,718
Miscellaneous vegetables	2,196,705

CALIFORNIA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					1,610,167
1890	3,504,251	287,799	37,659	157,514	3,887,229
1890	3,947,200	158,356	28,419	62,293	[a]4,196,268

[a]Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	5,771,323
1889	13,679,423
1890	24,443,540

The number of poultry over three months old in California in 1900 was 4,196,268. Poultry of all ages were worth $1,877,489. The poultry and eggs produced in 1899 were valued at $6,356,746, of which $3,864,679 was for eggs and $2,492,067 was for poultry. These composed 17.5 per cent of the animal products.

The value of all animal products was given as $36,324,894. Of the items composing this large sum, only two exceeded in value the poultry and eggs, namely, animals sold, with a value of $13,305,165, and dairy products, with a value of $12,128,471. The wool clip of that State was worth but $1,707,088, falling behind the poultry products to the extent of $4,648,658.

The number of eggs produced in 1899 was 24,443,540 dozens, and their average value per dozen was 15.8 cents.

The relative position of poultry products among other leading farm products is shown in the following statement:

Wheat	$20,179,044
Hay and forage	19,436,398
Orchard fruits	14,526,786
Animals sold	13,305,165
Dairy products (milk, butter, and cheese)	12,128,471
Barley	10,645,723
Tropical fruits	7,219,082
Poultry and eggs	6,356,746
Grapes	5,622,825

COLORADO.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					143,804
1890	710,942	20,872	1,096	12,105	745,015
1900	968,761	30,781	2,576	15,002	[a] 1,017,120

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	520,820
1889	2,685,109
1899	5,704,290

While the value of the poultry of Colorado in 1900 was $393,219, the value of the eggs produced during the one year of 1899 was $852,978 and the value of the poultry disposed of during the same period was $587,536. The total value of the poultry products was $1,440,514.

Colorado's total animal products in 1899 were valued at $16,077,988, and poultry and eggs constituted 9 per cent of this sum. Animals sold, with a value of $8,477,587, and dairy products, with a value of $3,778,901, were the only animal products which exceeded in value the poultry and eggs.

The eggs produced in 1899 were 5,704,290 dozens, which was an increase over 1889 of 3,079,181 dozens and a number which was more than eleven times greater than the product of 1879. The average value per dozen of the eggs produced in 1899 was 15 cents.

An idea of the relative importance of poultry and eggs among the farm products of Colorado may be had from the following comparative statement:

Animals sold	$8,477,587
Hay and forage	8,159,279
Dairy products (milk, butter, and cheese)	3,778,901
Wheat	2,809,370
Potatoes	1,717,111
Poultry and eggs	1,440,514
Oats	1,121,745
Wool	1,115,331
Animals slaughtered	1,093,365

CONNECTICUT.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					782,637
1890	1,075,044	30,176	5,100	31,483	1,141,803
1900	1,073,026	7,717	3,530	14,100	[a]1,098,373

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	5,209,061
1889	5,637,590
1899	7,959,430

The number of poultry in Connecticut in 1900 was 1,098,373, valued at $644,050. The value of poultry products in 1889 was $2,507,526, of which $1,523,319 was for eggs and $984,207 was for poultry.

The total animal products amounted in value to $11,651,359, and poultry and eggs formed 21.5 per cent of this. Dairy products were valued at a higher figure, while the value of the animals sold, the item next in value, was $1,338,291 less. The value of the poultry on the farms ($644,050), added to that sold off ($984,207), exceeded the value of the eggs produced by $104,938 only.

The quantity of eggs produced was 7,959,430 dozens. This was an increase over 1889 of 2,321,840 dozens. The average price obtained for the egg product was a small fraction over 19 cents per dozen.

The relative position of the poultry industry with reference to other leading farm crops is shown below:

Dairy products (milk, butter, and cheese)	$7,090,188
Hay and forage	6,001,280
Tobacco	3,074,022
Poultry and eggs	2,507,526
Potatoes	1,714,658
Forest products	1,275,720
Animals sold	1,169,235
Miscellaneous vegetables	1,036,087
Orchard fruits	1,011,359

DELAWARE.

Number of poultry on farms, 1880, 1890, and 1900.

Years.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					364,899
1890	900,212	70,578	10,525	50,046	1,031,361
1900	628,866	19,045	6,438	10,933	[a] 665,282

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	1,427,087
1889	2,218,754
1899	3,571,870

The number of poultry of all kinds in Delaware in 1900, as shown by the table above, was 665,282, an apparent (but not real) decrease from 1890 of 366,079. The value of the poultry of 1900 was $357,475, while the value of poultry products was $1,084,792, of which sum $596,391 represented the value of the poultry and $488,401 represented the value of the eggs.

The total value of all animal products was $2,915,417, and poultry and eggs comprised 37.2 per cent of this sum. In this State dairy products fell behind poultry products to the extent of $91,985.

Although there was an apparent decrease in the number of poultry during the interval between the census reports, eggs produced in 1899 exceeded the number produced in 1889 by 1,353,116 dozens, there being 2,218,754 dozens in 1889 and 3,571,870 dozens in 1899. The average price per dozen of the eggs produced in 1899 was 13.7 cents.

Some reports of other leading farm products are given below in order to show the relative importance of the poultry industry:

Corn	$1,725,452
Wheat	1,247,055
Poultry and eggs	1,084,792
Dairy products (milk, butter, and cheese)	992,807
Hay and forage	989,848
Small fruits	461,621
Animals slaughtered	424,400
Animals sold	396,264

DISTRICT OF COLUMBIA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					6,982
1890	10,543	215	84	291	11,133
1900	8,004	46	16	227	[a] 8,293

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	35,836
1889	48,430
1899	42,580

The table above shows that practically all of the poultry in the District of Columbia in 1900 was chickens. The total was valued at $3,108, while the value of the poultry and egg products was $11,972. This large income, based upon an investment of $3,108 (representing poultry on farms), appears to make an absurd showing; but it will be remembered that chickens under 3 months old were not enumerated; and, it is quite certain that almost the entire $5,480 worth put upon the market were not over 3 months old. The value of the eggs was $6,492.

The dairy products were valued at $186,096, while all other animal products, except poultry and eggs, was only $2,970.

The number of eggs produced in 1899 was 42,580 dozens, which was 5,850 dozens fewer than the product of 1889. The eggs of 1899 brought an average price of 12.9 cents per dozen.

The relative standing of the poultry industry with other farm products is shown below:

Foliage and flower plants	$519,565
Dairy products (milk, butter, and cheese)	186,096
Miscellaneous vegetables	84,346
Hay and forage	22,772
Sweet potatoes	13,078
Poultry and eggs	11,972
Small fruits	7,855
Corn	6,322
Onions	3,270

FLORIDA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					544,080
1890	919,601	34,426	37,502	9,491	1,001,020
1900	1,107,816	32,869	36,658	6,877	[a]1,184,220

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	1,024,106
1889	2,788,991
1899	4,214,186

Florida does not stand out conspicuously as a poultry State, but her poultry products make a creditable showing in comparison with other leading farm products. The value of the poultry on the farms was $394,557, while the poultry products disposed of were worth $1,128,227, of which $553,524 was for eggs and $574,703 for poultry.

The value of all animal products was $4,810,524, and poultry and eggs composed 23.5 per cent of that sum. Dairy products exceeded in value that of poultry products by $348,376 only, and animals slaughtered had but $129,421 to spare.

The eggs produced in 1899 amounted to 4,214,186 dozens, and they were worth an average price of 13.1 cents per dozen. The gain in quantity over 1889 was 1,425,195 dozens.

The position of the poultry industry with reference to other leading farm crops is shown in the following statement:

Corn	$2,669,509
Cotton	2,591,796
Miscellaneous vegetables	1,911,684
Dairy products (milk, butter, and cheese)	1,468,603
Animals slaughtered	1,257,648
Poultry and eggs	1,128,227
Tropical fruits	945,607
Sweet potatoes	898,282
Peanuts	699,713

GEORGIA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					3,442,583
1890	7,357,934	148,797	291,676	105,537	7,903,944
1900	4,549,144	103,416	208,997	64,895	[a] 4,926,452

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	7,126,058
1889	11,522,788
1899	15,505,330

The value of all poultry in Georgia in 1900 was $1,458,055, but the total number shown in the table is short all that were less than 3 months old.

The value of the poultry products was $4,097,148, of which $2,481,610 was for poultry and $1,615,538 was for eggs.

The eggs produced in 1899 amounted to 15,505,330 dozens, being an increase over 1889 of 3,982,542 dozens, and more than double the product of 1879. The average value per dozen of the eggs produced in 1899 was 10.4 cents.

All animal products in 1899 were valued at $17,959,133, and eggs represented 22.8 per cent of this amount. Of the items of animal products, dairy products and animals slaughtered were the only ones which exceeded poultry products in value.

The following statement shows the relative position of poultry and eggs among the farm products:

Cotton	$42,534,235
Corn	17,155,868
Cotton seed	6,447,297
Dairy products (milk, butter, and cheese)	5,954,575
Animals slaughtered	5,892,046
Poultry and eggs	4,097,148
Forest products	3,217,119
Hay and forage	3,034,992
Miscellaneous vegetables	3,009,306

IDAHO.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					86,021
1890	231,547	6,433	1,447	7,296	246,723
1900	516,412	10,211	3,850	9,536	a540,009

a Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	268,731
1889	737,813
1899	2,879,590

The value of all poultry in Idaho in 1900 was $203,127. This was $262,377 less than the value of eggs produced in 1899 and $79,341 less than the value of the poultry produced during the same year. The value of the eggs produced in 1899 was $183,036 more than the poultry produced during the same year.

Poultry and eggs together were worth $747,972. Of this sum $465,504 was for eggs and $282,468 was for poultry.

Idaho produced 2,879,590 dozens of eggs in 1899 and they were worth an average price of 16.1 cents per dozen. The egg product was but 737,813 dozens in 1889, and 268,731 dozens in 1879.

The total value of animal products in 1899 was $8,784,364, and poultry products constituted 8.5 per cent of this sum.

The relative position of poultry and eggs among the farm products of Idaho is shown in the following statement:

Hay and forage	$4,238,993
Animals sold	3,909,454
Wool	2,210,790
Wheat	2,131,953
Dairy products (milk, butter, and cheese)	1,243,197
Poultry and eggs	747,972
Oats	702,955
Animals slaughtered	626,237

ILLINOIS.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					11,525,971
1890	21,463,525	1,043,947	725,904	735,660	23,969,036
1900	16,600,728	446,020	307,657	382,857	[a]17,737,262

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	35,978,297
1889	60,351,065
1899	86,402,670

At first glance Illinois appears to have fallen far behind 1890 in the matter of poultry production, but the footnote explains the reason for the apparent decrease. The production of eggs in 1899, which was about 25,000,000 dozen greater than in 1889, is sufficient evidence that this industry has made great strides in Illinois during the last census decade. In the matter of poultry on farms, Illinois ranks second among the States for chickens, second for turkeys, sixth for geese, and second for ducks. The value of all poultry on farms was estimated at $6,415,033. The poultry and egg product was more than three times greater than this, however, the value being $20,250,000—$11,307,599 for poultry and $8,942,401 for eggs.

The value of all farm products of animal origin was $130,816,905, and poultry and eggs formed 15.5 per cent of this sum, or $20,250,000, as stated above.

Illinois produced 86,402,670 dozens of eggs in 1899, holding third place for egg production among the States, as she had done in 1889 and 1879. These eggs were worth an average price of 10.3 cents per dozen.

The comparative statement below shows the position held by poultry and eggs among the farm crops of Illinois:

Corn	$115,092,567
Animals sold	69,462,993
Oats	36,990,019
Dairy products (milk, butter, and cheese)	29,638,619
Hay and forage	25,569,169
Poultry and eggs	20,250,000
Wheat	11,937,458
Animals slaughtered	10,154,596
Miscellaneous vegetables	5,028,148

INDIANA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					6,848,011
1890	12,307,903	505,111	434,778	348,001	13,595,793
1900	11,103,006	345,379	271,004	230,432	[a] 11,949,821

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	28,823,819
1889	48,621,660
1899	70,782,200

The value of the poultry on the farms in Indiana in 1900 was $4,222,409. This was $3,950,584 less than the value of the poultry sold off the farm during the calendar year of 1899 and $3,219,533 less than the value of the eggs produced during the same year.

The total value of the poultry products for 1899 was $15,614,937, of which $8,172,993 was for the poultry and $7,441,944 was for the eggs.

The eggs produced in 1899 amounted to 70,782,200 dozens, which exceeded the number produced in 1889 by 22,160,540 dozens. The average value of the eggs produced in 1899 was 10.5 cents per dozen.

All animal products in 1899 were valued at $81,947,922. Poultry and eggs constituted 19.1 per cent of this sum. The animals sold, with a value of $40,865,661, and dairy products, with a value of $15,739,594, were the only items among the animal products that exceeded in value the poultry products, and the latter by the small sum of only $124,657.

The statement below shows the relative position of the poultry industry among the farm products:

Corn	$51,752,946
Animals sold	40,865,661
Wheat	22,228,916
Hay and forage	20,227,197
Dairy products (milk, butter, and cheese)	15,739,594
Poultry and eggs	15,614,937
Animals slaughtered	8,016,595
Oats	7,458,682
Forest products	5,235,459

INDIAN TERRITORY.

The census reports for 1880 and 1890 do not give returns of poultry and eggs for Indian Territory. The report for 1900, which does not include poultry under 3 months old, is as follows:

	Number.
Chickens	1,960,505
Turkeys	92,509
Geese	77,216
Ducks	88,069
Total	2,218,299

The value of all poultry is given as $515,384. This sum is $110,034 less than the value of the eggs produced in 1899 and $132,460 less than the value of the poultry produced during the same year. The total value of the poultry and eggs was $1,293,362, of which $625,418 represented the eggs and $647,844 the poultry.

All animal products were worth $10,777,571, and poultry and eggs constitute 11.8 per cent of this sum. Animals sold, animals slaughtered, and dairy products were the three items among animal products which exceeded in value the poultry and eggs.

The eggs produced in 1899 were 6,949,640 dozens, and they were worth an average price of 9 cents per dozen.

A comparative statement will show the position occupied by poultry and eggs among the farm products of Indian Territory:

Corn	$6,999,018
Animals sold	6,415,707
Cotton	4,809,929
Animals slaughtered	1,557,139
Dairy products (milk, butter, and cheese)	1,504,747
Poultry and eggs	1,273,262
Hay and forage	1,139,079
Wheat	1,121,259
Oats	889,053

IOWA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					8,539,714
1890	20,201,706	940,849	261,695	547,023	21,978,273
1900	18,907,673	424,306	223,612	487,752	a 20,043,343

a Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	32,253,933
1889	69,448,339
1899	99,621,920

The number of poultry in Iowa in 1900 over 3 months old was 20,043,343, and they were worth $6,535,464. This State leads all others in the number of poultry and in the production of eggs. A comparison of values with previous census years can not be made, as the last census gave only values. The value of poultry products for one year, when compared with that of poultry for one year, is sufficient to cause astonishment. For instance, the value of poultry on the farm, as has been stated, was $6,535,464, while the poultry and eggs sold off the farm amounted to $19,508,526. Of the latter sum, $10,016,707 was for eggs and $9,491,819 was for poultry.

The number of dozens of eggs in 1899 was 99,621,920, which was an increase of about 20,000,000 dozen over 1889. The average price per dozen of the eggs was 10 cents.

The value of all animal products on the farm was $169,858,981, poultry products forming 11.5 per cent of this. The animals sold, with a value of $113,078,523, and the dairy products, with a value of $27,516,870, were the only two animal products worth more than poultry and eggs.

The statement below shows the relative position of poultry products in the farm economy of Iowa:

Animals sold	$113,078,523
Corn	97,297,707
Oats	33,254,987
Hay and forage	30,042,246
Dairy products (milk, butter, and cheese)	27,516,870
Poultry and eggs	19,016,707
Wheat	11,457,808

KANSAS.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					4,397,482
1890	15,943,345	530,397	117,916	485,097	17,076,755
1900	11,966,843	275,330	97,768	216,244	[a]12,556,185

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	17,432,286
1889	42,584,975
1899	73,190,590

The value of the poultry on the farms on June 1, 1900, was $4,356,997; the value of that which was sold and consumed in 1899 was $6,491,183. Eggs sold and consumed for the year 1899 amounted to the large sum of $7,327,111. Thus the value of the poultry products sold in one year exceed that of the poultry left on the farms by $9,461,297.

The production of eggs in 1899 was 73,190,590 dozens, as against 42,584,975 dozens in 1889. The increase over 1879 was 55,658.304 dozens. The average price per dozen of the eggs produced in 1899 was 9.9 cents.

Poultry raised and eggs produced in 1899 constituted 14.3 per cent of the total value of animal products disposed of, the sum of which was $96,372,849.

The census shows that the value of the poultry and egg product was exceeded by only four farm products of Kansas in 1899, namely, animals sold, corn, wheat, and hay and forage.

The position held by poultry and eggs among the leading farm crops of Kansas is shown in the following exhibit:

Animals sold	$64,596,534
Corn	58,079,738
Wheat	19,132,455
Hay and forage	18,499,287
Poultry and eggs	13,728,294
Dairy products (milk, butter, and cheese)	11,782,902
Animals slaughtered	5,864,274
Oats	4,915,896
Potatoes	2,485,800

KENTUCKY.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					5,976,065
1890	12,740,559	672,106	967,417	370,401	14,750,483
1900	6,849,079	279,749	541,576	185,064	a7,855,468

a Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	15,812,205
1889	24,691,437
1899	35,337,340

Kentucky furnishes another striking instance where the failure to enumerate the fowls makes it appear that there were only half as many fowls in 1899 as there were in 1889. That there was in reality no diminution in the number in 1899, but a large increase instead, is evidenced by the large egg production in 1899, when there were reported 10,645,903 dozens more than were reported in 1889. The value of all poultry on farms in 1899 was given as $2,723,221. That which was sold off was worth $3,460,607, and the eggs produced were worth $4,970,063, the total value of these two latter products being $8,430,670.

All animal products in 1899 were worth $44,303,940, and poultry and eggs constituted 19 per cent of this sum. Of the products of animal origin, dairy products ($9,985,540) and animals ($16,660,676) sold were the only ones which outvalued the poultry products.

There was an increase in the production of eggs from 24,691,427 dozens in 1889 to 35,337,340 dozens in 1899, the net increase being 10,645,903 dozens. The average value per dozen of the eggs in the latter year was 9.8 cents.

The relative position occupied by this industry among the leading farm products of Kentucky is shown below:

Corn	$29,423,996
Tobacco	18,541,982
Animals sold	16,660,676
Dairy products (milk, butter, and cheese)	9,985,540
Wheat	8,923,760
Poultry and eggs	8,430,670
Animals slaughtered	8,198,080
Hay and forage	6,100,647
Miscellaneous vegetables	4,181,122

LOUISIANA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					1,490,907
1890	2,246,907	74,680	149,312	67,112	2,536,011
1900	3,890,563	115,921	169,936	123,059	[a] 4,299,479

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	3,392,246
1889	5,933,700
1899	12,820,290

The poultry of all species of Louisiana in 1900 was valued at $1,057,889. The poultry and egg product for 1899 was valued at $2,706,829. Of this sum, $1,281,713 was for eggs, and $1,425,116 was for poultry.

The total value of animal products in 1899 was $10,012,759. Of the items composing the animal products, that of dairy products alone, with a value of $4,168,015, was worth more than the poultry and eggs.

The eggs produced in 1899 amounted to 12,820,290 dozens; this was an increase over 1889 of 6,886,590 dozens. The average value per dozen of the 1899 product was 10 cents.

The relative position occupied by poultry and eggs among the leading farm crops of Louisiana is shown below:

Cotton	$23,523,143
Sugar-cane products	14,627,282
Corn	10,327,723
Dairy products (milk, butter, and cheese)	4,168,015
Rice	4,044,489
Poultry and eggs	2,706,829
Animals slaughtered	1,929,437
Miscellaneous vegetables	1,647,424
Forest products	1,381,867
Animals sold	1,072,869

MAINE.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					998,741
1890	1,411,185	15,259	7,270	26,947	1,460,661
1900	1,564,853	6,437	4,566	9,708	[a]1,585,564

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	7,059,876
1889	9,384,252
1899	13,304,151

The total value of the poultry products in 1899 was $2,993,693, of which $995,468 was for poultry disposed of by consumption on the farm or by sale, and $2,038,225 was for eggs. The value of all poultry on farms in 1900 was only $756,153.

The value of all animal products of the farm was $15,159,415, and poultry and eggs represented 19.8 per cent of this. Of the animal products, those of the dairy ($8,182,344) only exceeded the value of poultry and eggs. The poultry products brought $2,675,108 more than the wool of Maine, $621,976 more than the animals sold, and $1,735,099 more than the slaughtered animals.

The eggs produced in 1899 was 13,304,151 dozens, and their average price per dozen was 15.2 cents.

The relative rank of poultry products among the leading products of the farm are shown in the following table:

Hay and forage	$10,641,546
Dairy products (milk, butter, and cheese)	8,182,344
Potatoes	3,711,999
Poultry and eggs	2,993,693
Forest products	2,652,249
Animals sold	2,371,717
Oats	1,374,573
Animals slaughtered	1,258,594

MARYLAND.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					1,457,725
1890	3,430,859	278,522	91,238	232,519	4,033,138
1900	2,113,544	101,782	33,389	56,930	[a] 2,305,645

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	4,984,776
1889	8,718,593
1899	12,511,450

While the value of poultry in Maryland was given at $1,158,020, the value of the poultry products of one year was $3,650,170. Of this sum $2,077,490 was for poultry and $1,572,682 was for eggs.

The total value of the animal products for 1899 was $13,606,450, and poultry and eggs represent 26.8 per cent of this sum. No other item among the animal products was so large in value, except dairy products, which amounted to $5,228,698, or $1,478,528 more than the value of poultry and eggs.

While the number of poultry was shown to be 1,727,493 fewer in 1900 than in 1890, due to the condition stated in the footnote to the table, the number of dozens of eggs produced increased from 8,718,593 in 1889 to 12,511,450 in 1899. The average price of the eggs produced in 1899 was 12.6 cents per dozen.

Some reports of other leading products of the farm are copied herewith in order to show the relative importance of the poultry industry:

Corn	$7,462,594
Wheat	6,484,088
Dairy products (milk, butter, and cheese)	5,228,698
Hay and forage	4,709,072
Miscellaneous vegetables	3,944,959
Poultry and eggs	3,650,172
Animals sold	2,372,560
Animals slaughtered	2,173,197

MASSACHUSETTS.

Number of poultry on farms in 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					962,968
1890	1,623,605	5,803	8,379	70,593	1,708,380
1900	1,625,269	3,018	6,389	46,017	a1,680,693

a Does not include fowls under 3 months old.

Production of eggs in 1879, 1889, and 1899.

	Dozens.
1879	6,571,553
1889	8,931,398
1899	12,928,630

The number of poultry of all species in Massachusetts in 1900 was 1,680,693. Adding those under 3 months old, they were valued at $1,018,119, while the value of the products for 1899 was $3,979,022. Of the latter sum, $2,571,341 represented the eggs produced and $1,407,681 the poultry.

All animal products for 1899 were valued at $19,140,730, and poultry and eggs comprised 20.8 per cent of this sum. Excepting dairy products (milk, butter, and cheese), valued at $12,885,744, the poultry and eggs exceeded in value all other animal products by $1,703,058.

Although the figures show fewer poultry in 1900 than in 1890, owing to the fact explained in the footnote to the table, the production of eggs increased from 8,931,398 dozens in 1889 to 12,928,630 dozens in 1899. The average price per dozen of the eggs of 1899 was 19.9 cents.

The values of some of the other farm products are copied herewith, in order to show the relative importance of poultry upon the farm:

Dairy products (milk, butter, and cheese)	$12,885,744
Hay and forage	9,056,854
Poultry and eggs	3,979,022
Miscellaneous vegetables	3,412,995
Forest products	1,944,714
Flowers and plants	1,639,760
Small fruits	1,493,714
Animals sold	1,284,454
Orchard fruits	1,170,868

MICHIGAN.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					4,087,014
1890	5,852,690	185,847	72,898	98,789	6,210,224
1900	8,033,531	191,863	73,267	106,399	[a] 8,405,060

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	20,762,171
1889	34,309,633
1899	54,318,410

Poultry on the farms of Michigan in 1900 was worth $2,685,829. This was $1,866,116 less than the value of the poultry sold in 1899 and $3,419,346 less than the value of the eggs sold in the same year. The value of the poultry and eggs produced in 1899 was $10,656,407, of which $4,551,945 represented the poultry and $6,104,462 the eggs. The increased value of the eggs over the poultry produced is especially noticeable in Michigan.

The eggs produced in the year 1899 was 54,318,410 dozens, which was an increase over 1889 of 20,008,777 dozens. The average value per dozen in 1899 was 11.2 cents.

The total value of the animal products was $53,921,966, and poultry and eggs represented 19.8 per cent of this amount. The animals sold, with a value of $18,343,856, and dairy products, with a value of $16,903,087, were worth more than the poultry and eggs, but no other item among the animal products approached the value of poultry and eggs.

The statement below shows that poultry and eggs occupy fifth place among the farm products of Michigan:

Hay and forage	$21,792,987
Animals sold	18,343,856
Corn	17,798,011
Dairy products (milk, butter, and cheese)	16,903,087
Wheat	12,921,925
Poultry and eggs	10,656,407
Oats	9,264,385
Forest products	7,530,369
Potatoes	6,759,342

MINNESOTA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					2,258,385
1890	4,448,831	151,459	69,224	74,697	4,744,211
1900	7,730,940	193,143	90,975	127,635	a 8,142,693

a Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	8,234,161
1889	20,354,498
1899	43,208,130

The poultry of Minnesota was valued in 1900 at $2,274,649, but the number given for that year of 8,142,693 does not include anything under 3 months old. It will be noted that even with this exception the number was nearly doubled over 1890. The increase in the production of eggs tells a still better story. The increase from 8,234,161 dozens in 1879 to 20,354,498 in 1889, and then to 43,208,130 in 1899, is wonderful.

The value of the poultry products in 1899 was $7,364,865, of which $4,437,148 was for eggs and $2,927,717 was for poultry. These two items comprised 16.2 per cent of the total animal products of that year. Dairy products and animals sold led the poultry and eggs.

The 43,208,130 dozens of eggs produced were worth an average price of 10.2 cents per dozen.

The relative position of poultry and eggs among the farm products of Minnesota is shown in the following statement:

Wheat	$50,601,948
Dairy products (milk, butter, and cheese)	16,623,460
Animals sold	16,046,622
Oats	15,829,804
Hay and forage	14,585,281
Corn	11,337,105
Poultry and eggs	7,364,865
Barley	7,220,739
Flaxseed	5,898,556

MISSISSIPPI.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					2,897,733
1890	5,631,784	194,398	474,688	63,727	6,364,597
1900	5,194,856	189,698	357,963	95,668	[a] 5,838,185

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	6,364,410
1889	11,393,498
1899	18,942,070

The poultry on the farms of Mississippi in 1900 were worth $1,655,319. The value of the poultry and egg crop of 1899 shows the worth of an investment like the above, for the eggs produced that year were valued at $1,871,765 and the poultry at $2,387,484, a total of $4,259,249.

All animal products in 1899 were valued at $17,608,507, and poultry and eggs represented 24.2 per cent of this sum. Of these, dairy products and animals slaughtered were the only items which were worth more than the poultry and eggs.

Eggs were produced in 1899 to the number of 18,942,070 dozens, this amount being an increase over 1889 of 7,548,572 dozens. The average value per dozen of the eggs was 9.8 cents.

The relative position occupied by the poultry and egg product among the leading farm crops of Mississippi is shown below:

Cotton	$47,340,314
Corn	18,873,934
Cotton seed	6,692,027
Dairy products (milk, butter, and cheese)	6,064,513
Animals slaughtered	4,818,416
Poultry and eggs	4,259,249
Forest products	3,023,626
Miscellaneous vegetables	2,807,652
Animals sold	2,208,466

MISSOURI.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					8,906,153
1890	22,785,848	928,751	849,230	627,959	25,191,788
1900	14,903,601	466,665	428,307	278,140	[a] 16,076,713

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	28,352,032
1889	53,147,418
1899	85,203,290

The value of the poultry in Missouri in 1900 was $5,720,359. That State ranked third in the number of chickens, second in the number of turkeys, second also in the number of geese, and third in the number of ducks.

The poultry and eggs produced in 1899 were worth $17,840,623. Of this $8,315,371 represented eggs and $9,525,252 represented poultry. This product was worth $2,798,263 more than the dairy products combined, and was exceeded in value by only one product of animal origin, namely, animals sold. The animals sold brought $9,765,879, which was but $240,627 more than the poultry sold for.

The egg product was 85,203,290 dozens, an increase over 1889 of 32,055,872 dozens. The average value of the eggs was 9.8 cents per dozen.

The animal products of the farms of Missouri in 1899 were valued at $97,841,944. Poultry and eggs made up 18.2 per cent of this sum.

The position held by this industry among the farm products of Missouri is shown in the following statement:

Corn	$61,246,305
Animals sold	54,018,809
Hay and forage	20,467,501
Poultry and eggs	17,840,623
Dairy products (milk, butter, and cheese)	15,042,360
Wheat	13,520,012
Animals slaughtered	9,765,879
Miscellaneous vegetables	5,388,460
Oats	4,669,185

MONTANA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					60,404
1890	233,660	5,077	722	4,193	243,652
1900	531,774	12,637	2,629	9,639	[a]556,679

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	208,794
1889	834,166
1899	3,002,890

Poultry of all ages in Montana in 1900 was valued at $296,806. The poultry and egg product of 1899 was worth $1,029,630, of which $398,487 was for poultry and $631,143 was for eggs.

All animal products of the State were worth $17,924,442, but poultry and eggs fall far down in the list, being but 5.8 per cent of the total.

The $3,002,890 dozens of eggs produced in 1899 were worth an average price of 20.6 cents per dozen.

The relative position held by this industry among the leading farm products of Montana is shown below:

Animals sold	$9,176,830
Hay and forage	5,974,850
Wool	5,136,658
Oats	1,790,938
Dairy products (milk, butter, and cheese)	1,669,978
Wheat	1,077,210
Poultry and eggs	1,029,630
Animals slaughtered	906,816
Potatoes	661,163

NEBRASKA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					1,839,092
1890	7,395,368	218,636	69,839	275,180	7,959,023
1900	7,417,837	118,892	74,007	201,503	[a] 7,812,239

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	7,166,090
1889	23,300,684
1899	41,132,140

The value of all poultry of all ages in Nebraska in 1900 was $2,374,930. It is necessary to show what the annual product is in order to give a proper idea of the importance of the industry. In the case of Nebraska, for instance, the poultry and egg product for the year 1899 was worth $7,567,046. Of this sum, $3,499,044 represented poultry and $4,068,002 represented eggs.

Animal products were worth $70,227,060, and poultry and eggs made up 10.8 per cent of this sum. The dairy products exceed poultry products by 2.6 per cent only.

By the very large increase in egg production—from 23,300,684 dozens in 1889 to 41,132,140 dozens in 1899—one may form some sort of estimate of the increase in the number of poultry for the same census decade. It will be observed that this increase was 17,831,456 dozens. The average value per dozen of the eggs in 1899 was 9.9 cents.

The relative importance of poultry and eggs among the leading farm products of Nebraska is shown in the following statement:

Animals sold	$49,022,404
Corn	51,251,213
Wheat	11,877,347
Oats	11,333,393
Hay and forage	11,230,901
Dairy products (milk, butter, and cheese)	8,595,408
Poultry and eggs	7,567,046
Animals slaughtered	4,508,457
Potatoes	1,734,666

NEVADA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					43,635
1890	62,167	4,193	525	2,718	69,603
1900	100,661	3,618	880	2,379	[a] 107,538

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	120,471
1889	170,725
1899	589,490

Nevada does not appear to be very much of a poultry State, yet the value of all poultry for the year 1899 was $55,826. A better showing is made for the poultry and eggs produced during the year 1899, when the value of the former was $71,175 and that of the latter was $122,522. The total value was $193,697. This sum constituted 5 per cent of the animal products of Nevada in 1899, when the total value of the animal products was $3,870,768.

The eggs produced in 1899 amounted to 589,490 dozens, which was an increase over the census returns of 1889 of 418,765 dozens. The average value of the eggs was 20.8 cents per dozen.

Poultry and eggs do not occupy a place so prominent among the products of Nevada as they do in most States, as may be seen by reference to the statement below:

Animals sold	$2,260,221
Hay and forage	2,066,496
Wool	692,403
Dairy products (milk, butter, and cheese)	433,391
Animals slaughtered	270,228
Wheat	263,351
Potatoes	194,619
Poultry and eggs	193,697
Barley	126,748

NEW HAMPSHIRE.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					506,127
1890	934,322	10,207	2,795	17,031	964,355
1900	870,461	2,386	1,289	3,803	a 877,939

a Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	3,347,211
1889	5,049,150
1899	7,005,180

The poultry of New Hampshire in 1900 numbered 877,939, valued at $467,104. The value of the poultry products was $1,824,399, of which $1,213,703 represented the poultry and $610,696 the eggs.

All animal products were valued at $9,654,694, and poultry products comprised 18.9 per cent of this. Dairy products comprised the only item among the animal products which was valued higher.

The table above shows that the number of poultry in 1900 was fewer by 86,416 than in 1890 (see footnote above for explanation); yet it appears that the production of eggs increased by 1,956,030 dozens. The average value per dozen of the eggs produced in 1899 was 17.3 cents. It is interesting to note that the value of the eggs produced exceeded the value of the poultry by $603,007.

Some reports of other leading farm products are given herewith in order to show the relative importance of the poultry industry:

Hay and forage	$6,336,252
Dairy products (milk, butter, and cheese)	5,591,272
Forest products	2,299,327
Poultry and eggs	1,824,399
Animals sold	1,345,941
Potatoes	1,090,495
Animals slaughtered	794,342
Orchard fruits	707,729

NEW JERSEY.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					1,188,492
1890	2,990,698	162,270	20,367	113,668	3,287,003
1900	1,993,594	32,378	10,518	40,024	[a] 2,076,514

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	6,686,142
1889	8,031,571
1899	11,942,550

The number of poultry of all classes in New Jersey in 1900 was 2,076,514. These were valued at $1,300,853, while the value of their products was $4,204,120. Of the latter sum, $2,265,816 represent the value of the poultry and $1,938,304 the value of the eggs.

The total value of all animal products was $15,740,688, of which poultry and eggs represented 26.7 per cent. As is shown for so many States, dairy products comprise the only item among the animal products which exceeded in value the poultry and eggs. Animals sold fell behind poultry and eggs to the extent of $2,565,353, and animals slaughtered $2,997,933.

The number of poultry reported in 1890 was 3,287,003, while in 1900 it was 2,076,514, showing a decrease of 1,210,487 for the latter year. Notwithstanding this, the eggs increased from 8,031,571 dozens in 1889 to 11,942,550 dozens in 1899. The average price of the eggs produced in 1889 was 16.3 cents per dozen.

Some reports of other leading farm products are copied herewith in order to show the relative importance of the poultry industry:

Dairy products (milk, butter, and cheese)	$8,436,869
Hay and forage	5,544,970
Miscellaneous vegetables	4,914,803
Corn	4,533,473
Poultry and eggs	4,204,120
Orchard fruits	2,594,981
Potatoes	2,192,456
Animals sold	1,638,767
Animals slaughtered	1,406,187

NEW MEXICO.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					49,199
1890	60,596	928	216	1,104	62,844
1900	156,853	3,805	830	1,527	[a] 163,015

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	238,858
1889	279,664
1899	839,890

The poultry of New Mexico was worth $62,419, while the poultry products were worth $247,327. Of this latter sum, $157,175 was for eggs and $90,152 was for poultry.

The value of all animal products was $7,090,648, and 3.5 per cent of this represented the value of the poultry and eggs.

The eggs produced in 1899 was 839,890 dozens, being an increase over 1889 of 560,226 dozens. The average value per dozen was 18.7 cents. Values for previous years are not given in the census reports; therefore comparisons of values can not be made.

The relative importance of the poultry industry is shown below, in comparison with some of the other leading farm products:

Animals sold	$3,740,678
Wool	1,954,171
Hay and forage	1,427,317
Animals slaughtered	605,296
Dairy products (milk, butter, and cheese)	499,423
Corn	419,936
Wheat	390,616
Poultry and eggs	247,327
Orchard fruits	197,331

NEW YORK.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					6,945,292
1890	8,421,667	402,642	80,403	301,419	9,206,131
1900	8,964,736	190,879	45,933	150,864	[a] 9,352,412

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	31,958,739
1889	45,807,106
1899	62,096,690

The value of all poultry in New York in 1900 was $4,310,755. This was $4,319,307 less than the value of the eggs produced in 1899 and $1,850,674 less than the value of the poultry sold during the same year. The value of the poultry and eggs produced in 1899 was $14,791,491, of which sum $8,630,062 represented the eggs and $6,162,429 the poultry.

The value of all animal products in 1899 was $95,352,247, and the item of poultry and eggs constituted 15.5 per cent of this sum. As usual, dairy products, with a value of $55,474,175, and animals sold, with a value of $15.025,932, were the only animal products which exceeded in value the poultry and eggs.

The eggs produced amounted to 62,096,690 dozens, and they were worth an average of 13.8 cents per dozen. The increase of egg production over 1889 was 16,289,584 dozens, and was about double the production of 1879.

Poultry and eggs together occupies fifth place among the leading farm products of New York, as shown by the following statement:

Dairy products (milk, butter, and cheese)	$55,474,155
Hay and forage	55,237,446
Animals sold	15,025,932
Potatoes	15,019,135
Poultry and eggs	14,791,491
Oats	12,929,092
Orchard fruits	10,542,272
Animals slaughtered	8,319,750

NORTH CAROLINA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					2,969,456
1890	7,507,593	197,420	375,991	169,409	8,250,413
1900	3,871,858	120,737	284,424	102,942	[a] 4,379,961

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	7,455,132
1889	11,755,635
1899	17,704,020

The value of all poultry in North Carolina in 1900 was $1,434,158, which was $1,255,812 less than the value of the poultry sold during the one year of 1889 and $375,958 less than the value of the eggs disposed of for the same year. The total value of the poultry and eggs was $4,500,086, which sum represented 21.8 per cent of the total value of animal products.

All animal products for the year 1889 were worth $20,684,727, and, as is so often the case in the Western States, the two items of animals slaughtered and dairy products were the only ones among the animal products which exceeded the value of poultry and eggs.

The eggs produced in 1899 were 17,704,020 dozens, which was an increase over 1889 of 5,948,385 dozens. The average value per dozen of the egg product was 10.2 cents.

A comparative statement as given below shows the relative position of the poultry and egg product with reference to other leading farm products:

Corn	$17,304,407
Cotton	15,696,952
Tobacco	8,038,691
Animals slaughtered	7,109,655
Dairy products (milk, butter, and cheese)	6,175,397
Forest products	4,921,740
Poultry and eggs	4,500,086
Wheat	3,463,726
Miscellaneous vegetables	3,034,895

NORTH DAKOTA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					[a]302,491
1890	804,388	33,928	9,593	11,592	859,501
1900	1,409,205	39,073	17,206	23,816	[b]1,489,300

[a] Total for Dakota Territory before its division into North Dakota and South Dakota.
[b] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	1,012,613
1889	3,552,664
1899	7,438,400

All poultry in North Dakota in 1900 was valued at $477,358; this was $305,432 less than the value of the eggs produced in 1899 and $117,393 less than the poultry products for the same year. The eggs produced during that year were worth $178,039 more than the poultry product. The eggs produced in 1899 amounted to 7,438,400 dozens, and these were worth an average of 10.5 cents per dozen. The increase in production over 1889 was 3,885,736 dozens. The total value of poultry and eggs was $1,377,541, of which eggs are represented by $782,790 and poultry by $594,751.

The total value of animal products in 1899 was $10,211,677, and poultry and eggs constituted 13.5 per cent of this sum.

The following statement shows the relative position of poultry and eggs among the farm products:

Wheat	$31,733,763
Flaxseed	7,735,740
Oats	5,852,615
Hay and forage	5,182,917
Animals sold	3,902,074
Dairy products (milk, butter, and cheese)	2,853,133
Barley	1,996,082
Animals slaughtered	1,573,588
Poultry and eggs	1,377,541

OHIO.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					9,939,927
1890	13,659,359	521,171	277,225	409,698	14,867,453
1900	14,269,525	362,924	179,665	206,238	[a]15,018,352

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	43,092,291
1889	70,162,240
1899	91,766,630

The number of poultry of all kinds in Ohio, not including fowls under 3 months old, was 15,018,352, and the value of poultry of all ages was $5,085,921. In the number of chickens, Ohio ranked fourth among the States, fifth for turkeys, and sixth for ducks.

The value of the poultry and eggs sold off the farm in 1899 was $19,127,778, of which $10,280,769 represented eggs and $8,847,009 represented poultry.

The eggs produced in 1899 were 91,766,630 dozens, being an increase over 1889 of 21,604,390 dozens, or 30.8 per cent. The average value per dozen of the egg product of 1899 was 11.1 cents.

The total value of the animal products sold off the farm in 1899 was $100,213,468. Of these, two items only exceeded in value the poultry and eggs, namely, dairy products, valued at $25,383,627, and animals sold, valued at $40,873,674. Poultry and eggs constituted 19.1 per cent of the value of the animal products sold.

The place occupied by this industry among the leading farm products of Ohio is shown by the following table:

Corn	$48,037,895
Animals sold	40,873,674
Hay and forage	29,047,532
Dairy products (milk, butter, and cheese)	25,383,627
Poultry and eggs	19,127,778
Animals slaughtered	10,276,931
Oats	10,236,251
Orchard fruits	6,141,118
Potatoes	5,750,068

OKLAHOMA.[a]

Number of poultry on farms, 1890 and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1890	388,427	5,931	725	4,484	399,567
1900	2,527,353	86,450	12,934	71,562	[b]2,698,299

[a] Oklahoma became a Territory by act of Congress approved May 2, 1890.
[b] Does not include fowls under 3 months old.

Production of eggs, 1889 and 1899.

	Dozens.
1889	989,625
1899	13,724,900

Oklahoma became a Territory by the act approved May 2, 1890, and the census of that year showed that there were within her borders 399,567 fowls. This number had increased enormously during the succeeding ten years, there being a total in 1900, exclusive of fowls under 3 months old (not enumerated), of 2,698,299. All fowls upon farms were valued in 1900 at $900,743.

The production of eggs increased from 989,625 dozens in 1889 to 13,724,900 dozens in 1899. This is one of the striking evidences of the rapid development of this Territory since it was opened for settlement in 1889. The eggs produced in 1899 were valued at an average of 9.3 cents per dozen.

The value of all animal products in 1899 was $18,582,351. Of this sum, eggs, valued at $1,284,414, and poultry, with a value of $1,302,460, constituted 13.9 per cent. Dairy products fell behind poultry and eggs to the sum of $105,201, and animals slaughtered exceeded the latter in the sum of $338,972. Animals sold ($10,547,764) was the second item among animal products which was worth more than the poultry and eggs.

The importance of poultry upon farms of Oklahoma is shown in the following statement:

Animals sold	$10,547,764
Wheat	8,989,416
Corn	8,699,271
Animals slaughtered	2,925,846
Hay and forage	2,883,682
Poultry and eggs	2,586,874
Dairy products (milk, butter, and cheese)	2,481,673
Cotton	2,217,119
Oats	1,079,862

OREGON.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					490,895
1890	1,180,765	43,555	21,389	32,325	1,278,034
1900	1,290,818	36,031	26,580	19,774	[a]1,373,203

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	1,654,738
1889	4,453,933
1899	7,709,970

Poultry of all kinds in Oregon in 1900 was valued at $582,524. The poultry and eggs sold off the farms, however, were worth nearly four times as much, namely, $1,988,758. Of this latter sum $1,162,071 was for eggs and $826,687 was for poultry.

All farm products of animal origin in Oregon were valued at $16,284,282, and poultry and eggs formed 12.2 per cent of this sum.

The egg production in 1899 was 7,709,970 dozens, this being an increase over the previous census returns of 3,156,037 dozens. The average value per dozen was 15 cents.

The relative position of poultry and eggs among the leading farm crops of the State is shown below:

Animals sold	$6,598,325
Wheat	6,358,395
Hay and forage	6,147,018
Dairy products (milk, butter and cheese)	3,550,953
Wool	2,396,741
Oats	2,078,950
Poultry and eggs	1,988,758
Animals slaughtered	1,565,895
Forest products	1,300,724

PENNSYLVANIA.

Number of poultry on farms, 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					7,360,803
1890	10,381,781	535,828	106,538	357,238	11,381,385
1900	10,553,106	259,824	60,780	171,271	[a]11,044,981

[a] Does not include fowls under 3 months old.

Production of eggs, 1879, 1889, and 1899.

	Dozens.
1879	34,377,889
1889	50,049,915
1899	67,038,180

The increased production of eggs in 1899 over 1889 shows that there must have been a large increase in the number of poultry. The value of all poultry on farms in 1900 was $4,483,486. Poultry and eggs produced in 1899 were worth $16,231,968, being outvalued among the products of animal origin by dairy products only. Of the above sum $7,151,243 was for poultry and $9,080,725 was for eggs. The eggs, therefore, were worth $1,929,482 more than the poultry.

Eggs were produced in 1899 to the amount of 67,038,180 dozens, this being an increase over the previous census year of 16,988,265 dozens. These eggs were worth an average of 13.5 cents a dozen.

A comparative statement of the leading farm products of Pennsylvania places poultry and eggs in fourth place, as shown by the statement below:

Hay and forage	$37,514,779
Dairy products (milk, butter, and cheese)	35,860,110
Corn	21,896,795
Poultry and eggs	16,231,968
Animals sold	15,494,178
Wheat	13,712,976
Animals slaughtered	11,627,980
Oats	11,093,893
Potatoes	9,397,054

RHODE ISLAND.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					269,759
1890	482,370	11,656	16,805	13,706	524,537
1900	500,618	4,604	6,335	8,957	[a] 520,514

[a] Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899.

	Dozens.
1879	1,564,934
1889	2,020,714
1899	3,217,310

The poultry of Rhode Island was valued at $305,047. The number of poultry, not including that under 3 months old, was 520,514.

The value of the poultry products sold in 1899 was $1,055,635, of which $656,845 was for poultry and $389,790 was for eggs.

The total value of all animal products was $3,292,295, and the poultry products constituted 31.2 per cent of this amount. Dairy products, with a value of $1,923,707, is the only item among the products of animal origin which exceeded poultry and eggs in value.

The quantity of eggs produced in 1899 was 3,217,310 dozens; in 1889 the quantity was 2,020,714 dozens. The average value per dozen of the product of 1899 was 20.4 cents.

Some reports of other leading farm products are given below in order to show the relative importance of the poultry industry:

Dairy products (milk, butter, and cheese)	$1,923,707
Hay and forage	1,081,482
Poultry and eggs	1,055,635
Miscellaneous vegetables	487,808
Potatoes	440,372
Flowers and plants	314,806

SOUTH CAROLINA.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					1,417,629
1890	3,873,798	149,126	121,525	47,099	4,191,548
1900	2,664,784	120,140	83,543	39,852	[a]2,908,319

[a] Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899.

	Dozens.
1879	3,416,846
1889	5,702,141
1899	9,007,700

The total value of all poultry, including in addition to the above those under 3 months old, was $889,953. The poultry and eggs produced in 1899 were worth, respectively, $1,539,755 and $925,966, the total being $2,465,721.

All animal products were worth $9,376,499, and poultry and eggs formed 26.3 per cent of this sum. Dairy products, worth $3,232,725, and animals slaughtered, worth $2,730,079, were the only animal products which were worth more than the poultry and eggs.

The eggs produced in 1899 amounted to 9,007,700 dozens, which was 3,305,559 dozens in excess of the production of 1889. The eggs produced in 1899 were worth on an average 12.8 cents per dozen.

The position occupied by poultry and eggs among the leading farm products of South Carolina is shown in the following statement:

Cotton	$29,590,152
Corn	9,149,808
Cotton seed	4,973,401
Dairy products (milk, butter, and cheese)	3,232,725
Animals slaughtered	2,730,079
Poultry and eggs	2,465,721
Hay and forage	2,304,734
Miscellaneous vegetables	2,079,862
Forest products	1,915,134

SOUTH DAKOTA.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					(a)
1890	2,292,866	60,163	22,465	48,632	2,424,126
1900	3,028,700	53,740	33,334	62,511	b3,178,285

a South Dakota was admitted as a separate State on November 3, 1889.
b Does not include fowls under 3 months old.

Production of eggs 1889 and 1899.

	Dozens.
1889	8,777,993
1899	17,349,750

Although fowls under 3 months old were not taken into account in 1900, there was an increase in that year of 754,159 over the year 1890. In 1900 the value of all fowls was $856,966.

Eggs and poultry which were produced in 1899 were worth $2,747,774, of which $1,727,392 represented eggs and $1,020,382 represented poultry. Dairy products and animals sold were the only other products of animal origin which outvalued poultry and eggs.

All animal products were worth $21,906,804, and poultry and eggs formed 12.5 per cent of this sum.

The eggs produced in 1899 amounted to 17,349,750 dozens, showing a gain over 1889 of 8,571,757 dozens. The average value per dozen of the egg crop of 1899 was 9.9 cents.

The position occupied by this industry among the leading farm products of South Dakota is shown in the statement below:

Wheat	$20,957,917
Animals sold	12,707,831
Corn	7,263,127
Hay and forage	5,954,229
Dairy products (milk, butter, and cheese)	4,351,568
Oats	4,114,456
Poultry and eggs	2,747,774
Flaxseed	2,422,269
Barley	2,003,540

TENNESSEE.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					5,404,721
1890	12,062,139	430,333	778,128	361,984	13,632,584
1900	6,184,210	193,397	391,698	202,432	[a]6,971,737

[a] Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899.

	Dozens.
1879	16,347,482
1889	23,172,313
1899	31,807,990

The great difference between the number of poultry in 1890 and 1900 as shown in the table is not real, for the latter year does not include poultry under 3 months old. The egg production of 31,807,990 dozens, which was an increase over the Eleventh Census figures of 8,635,677 dozens, is the best evidence that there was a large increase in the number of poultry instead of a decrease, as shown by the table. The value of the poultry on farms in 1900 was $2,275,864.

The egg product of 1899 was worth $3,115,335 and the poultry product $4,282,740, the total being $7,398,075. The average value per dozen of the eggs was 9.8 cents.

The total value of the animal products of 1899 was $35,421,198, and of this sum poultry and eggs formed 20.9 per cent.

The position held by this industry among the leading farm products of Tennessee is shown in the following statement:

Corn	$28,059,508
Animals sold	11,121,141
Animals slaughtered	8,350,046
Cotton	8,192,642
Dairy products (milk, butter, and cheese)	8,028,466
Wheat	7,882,697
Poultry and eggs	7,398,075
Hay and forage	6,811,577
Forest products	5,086,624

TEXAS.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					4,295,867
1890	11,523,717	535,916	528,149	391,086	12,978,868
1900	13,562,302	648,671	415,709	234,664	[a]14,861,346

[a] Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899.

	Dozens.
1879	11,486,566
1889	32,466,433
1899	58,040,810

In the number of chickens in 1900 Texas ranked fifth among the States. She ranked fourth for ducks, with a total of 234,664; third for geese, with a total of 415,709, and first for turkeys, with a total of 648,671. The value of the 14,861,346 fowls, including all under 3 months old (not enumerated), was $3,595,243.

The value of the eggs produced in 1899 was $4,672,187, and the value of poultry product $5,311,362, a total of $9,983,549. Three other items only among the animal products—dairy products, animals slaughtered, and animals sold—exceeded the value of the poultry and eggs. The value of all animal products was $72,852,533, and poultry and eggs constituted 13.7 per cent of this sum.

The eggs produced amounted to 58,040,810 dozens, this being an increase over 1889 of 25,574,377 dozens. The average value per dozen of the eggs in 1899 was 7.7 cents. This was the lowest average value in any State.

The relative position of poultry and eggs among the leading farm products of Texas is shown by the following statement:

Cotton	$84,332,713
Corn	34,424,871
Animals sold	34,357,265
Dairy products (milk, butter, and cheese)	15,504,978
Cotton seed	12,396,591
Animals slaughtered	11,032,614
Poultry and eggs	9,983,549
Hay and forage	7,294,450
Wheat	7,051,477

UTAH.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					222,616
1890	279,983	9,220	1,451	5,655	296,309
1900	534,842	10,649	2,759	8,503	[a]556,753

[a] Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899.

	Dozens.
1879	826,237
1889	1,131,071
1899	3,387,340

The value of the poultry on the farms of Utah in 1900 was $186,922. The value of the poultry and eggs disposed of in 1899 was $687,131, of which sum $424,628 was for eggs and $262,503 was for poultry.

Eggs were produced to the amount of 3,387,340 dozens, this being an increase over the previous census of 2,256,269 dozens. The eggs averaged in value 12.5 cents per dozen.

All animal products were valued at $8,259,080, and poultry and eggs formed 8.3 per cent of this sum.

The following statement shows the relative rank of poultry and eggs among the leading farm products:

Hay and forage	$3,862,820
Animals sold	2,695,504
Wool	2,599,638
Wheat	1,575,064
Dairy products (milk, butter, and cheese)	1,522,932
Poultry and eggs	687,131
Animals slaughtered	659,369
Oats	553,847
Potatoes	487,816

VERMONT.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					567,828
1890	789,278	72,164	10,838	13,047	885,327
1900	806,451	22,689	5,187	8,836	[a]843,163

[a] Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899.

	Dozens.
1879	3,050,131
1889	4,515,130
1899	6,271,880

The value of poultry in 1900 was $421,195, while the value of poultry products in 1899 was $1,649,074. Of this latter sum, $959,965 was for eggs and $689,109 for poultry.

The value of all animal products was $15,400,613, and poultry products constituted 10.7 per cent of this amount. Dairy products, with a value of $9,321,389, and animals sold, with a value of $2,786,137, exceeded the value of poultry products. The animals slaughtered were worth $311,320 less than the poultry products.

The number of eggs produced in 1899 was 6,271,880 dozens, while the number was 4,515,130 dozens in 1889, and 3,050,131 dozens in 1879. The average price per dozen in 1899 was 13.7 cents.

In order to show the relation of poultry products to other leading farm products, the following statement is shown:

Hay and forage	$10,544,825
Dairy products (milk, butter, and cheese)	9,321,389
Animals sold	2,786,137
Forest products	2,108,518
Poultry products	1,649,074
Animals slaughtered	1,347,754
Potatoes	1,333,730
Corn	1,180,505

VIRGINIA.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					2,647,157
1890	6,576,260	477,414	216,175	299,142	7,568,991
1900	4,590,311	207,675	125,495	117,989	[a]5,041,470

[a] Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899

	Dozens.
1879	8,950,629
1889	13,557,571
1899	25,550,460

The apparent decrease in the number of fowls in Virginia during the decade between census reports is not real, as may be known by reference to the production of eggs, which nearly doubled during this time. All poultry on the farms in 1900 were worth $1,886,768, a small sum compared with the poultry and eggs sold off; this was $3,744,654 for poultry and $2,836,899 for eggs, a total value of $6,581,553.

The eggs produced in 1899 amounted to 25,550,460 dozens, while in 1889 the amount was 13,557,751 dozens, the increase being 11,892,889 dozens. The eggs of 1899 were worth an average of 11.1 cents per dozen.

All products of animal origin were valued at $27,846,803, of which poultry and eggs formed 23.6 per cent. Only two items—dairy products ($6,999,994) and animals sold ($7,800,124)—outvalued the poultry and eggs.

The relative position occupied by this industry among the leading farm products may be seen by reference to the table below:

Corn	$16,233,756
Animals sold	7,800,124
Hay and forage	7,670,082
Tobacco	7,210,195
Dairy products (milk, butter, and cheese)	6,999,994
Poultry and eggs	6,581,553
Wheat	6,161,000
Animals slaughtered	5,859,531
Miscellaneous vegetables	4,725,160

WASHINGTON.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					147,129
1890	779,972	17,187	5,847	14,122	817,128
1900	1,196,639	29,155	64,488	66,433	a 1,356,715

a Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899.

	Dozens.
1879	501,448
1889	2,710,520
1899	7,473,790

In 1900 the poultry of Washington was valued at $614,838. This sum was less than one-third of the value of the poultry and eggs produced in 1899, which was $2,107,516. Of this, $1,259,225 was for eggs and $848,291 was for poultry. The two items of dairy products ($3,816,691) and animals sold ($3,517,053) among the animal products exceeded in value the poultry and eggs.

All animal products in 1889 were worth $11,295,345, and poultry and eggs formed 18.6 per cent of this sum.

The production of eggs in 1899 was 7,473,790 dozens, and in 1889 the amount was 2,710,520 dozens, showing an increase for 1899 of 4,763,270 dozens. The average value of the eggs was 16.9 cents per dozen.

The relative position of the poultry and egg industry in Washington is shown in the following statement:

Wheat	$9,028,209
Hay and forage	5,831,088
Dairy products (milk, butter, and cheese)	3,816,691
Animals sold	3,517,053
Poultry and eggs	2,107,516
Oats	1,765,547
Potatoes	1,312,948
Barley	1,268,480
Animals slaughtered	1,168,802

WEST VIRGINIA.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					1,607,201
1890	3,197,447	214,756	176,723	133,942	3,722,868
1900	2,759,585	105,265	129,948	58,273	[a]3,053,071

[a]Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899.

	Dozens.
1879	6,741,893
1889	9,919,974
1899	17,242,400

Poultry of all ages in West Virginia was worth $963,805. The egg product was worth $1,877,675 and the poultry sold off was worth $1,843,752.

The total value of the animal products was $19,072,790, and poultry and eggs formed 19.5 per cent of this sum. Among the products of animal origin, dairy products, valued at $5,088,153, and animals sold, valued at $6,533,034, were the only ones which outvalued poultry and eggs.

The production of eggs in 1899 amounted to 17,242,400 dozens, this being an increase over 1889 of 7,323,426 dozens. The eggs were worth an average of 10.9 cents per dozen.

The position occupied by poultry and eggs among the leading farm crops of West Virginia is shown in the statement below:

Corn	$7,698,335
Animals sold	6,533,034
Hay and forage	5,517,073
Dairy products (milk, butter, and cheese)	5,088,153
Poultry and eggs	3,721,427
Wheat	3,040,314
Animals slaughtered	2,895,032
Forest products	2,632,980
Orchard fruits	2,155,509

WISCONSIN.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					3,855,726
1890	5,646,294	206,230	130,082	91,206	6,173,812
1900	8,097,399	155,121	102,224	92,800	[a] 8,447,544

[a] Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899.

	Dozens.
1879	15,826,025
1889	29,390,784
1899	46,249,580

The poultry on the farms of Wisconsin in 1899 was worth $2,410,714. The value of the poultry and eggs disposed of was $8,252,447, of which $4,854,020 represented eggs and $3,398,427 represented poultry. Dairy products and animals sold were the only other items of animal origin which exceeded in value the poultry and eggs.

Products of animal origin amounted in value to $69,303,364, and poultry and eggs constituted 11.9 per cent of this sum.

The egg production was 46,249,580 dozens, being an increase over the previous census of 16,858,796 dozens. The average value per dozen of the eggs produced in 1899 was 10.5 cents.

A comparison of the value of some of the leading farm crops of Wisconsin shows the position held by poultry and eggs:

Animals sold	$27,131,916
Dairy products (milk, butter, and cheese)	26,779,721
Hay and forage	19,267,709
Oats	17,931,685
Corn	15,905,822
Poultry and eggs	8,252,447
Forest products	6,109,033
Potatoes	5,826,552
Animals slaughtered	5,407,114

WYOMING.

Number of poultry on farms 1880, 1890, and 1900.

Year.	Chickens.	Turkeys.	Geese.	Ducks.	Total.
1880					11,167
1890	73,694	2,441	155	1,797	78,087
1900	142,136	3,664	1,312	2,452	[a] 149,534

[a] Does not include fowls under 3 months old.

Production of eggs 1879, 1889, and 1899.

	Dozens.
1879	30,740
1889	332,221
1899	937,570

The value of all poultry in Wyoming in 1900 was $60,397. The value of poultry products, however, was much greater, being $243,005. Of this sum, $163,517 was for eggs and $79,488 was for poultry.

This industry formed but 2.8 per cent of the animal production, owing to the fact that Wyoming is preeminently a stock-growing State.

The eggs produced in 1899 amounted to 937,570 dozens, an increase over 1889 of 605,349 dozens. The average value per dozen in 1899 was 17 cents.

The position occupied by this industry among the leading farm crops of Wyoming is shown below:

Wool	$4,036,227
Animals sold	3,673,124
Hay and forage	2,332,028
Dairy products (milk, butter, and cheese)	421,613
Animals slaughtered	394,635
Oats	292,630
Poultry and eggs	243,005
Wheat	191,195
Potatoes	138,368

ALASKA.

"From the standpoint of income upon capital invested, poultry raising in 1899 was relatively the most profitable branch of Alaskan agriculture. The stock on hand June 1, 1900, consists of 176 fowls valued at $166. The total income was $539 in 1899. Of this sum $360 was derived from eggs and $179 more from the sale of chickens. Eggs found a ready market at an average price of 43 cents per dozen, while the average amount received for fowls was $1.01 each." (Census Bulletin.)

HAWAII.

The reports for the Territory of Hawaii show the presence in 1900 of the following fowls:

	Number.
Chickens	31,888
Turkeys	4,672
Geese	75
Ducks	21,508
Total	58,143

These were valued at $38,237. The value of poultry and eggs disposed of was $61,546 for the former and $45,257 for the latter—a total product of $106,803.

The value of all animal products was $623,215, and poultry and eggs constituted 17.1 per cent of it. The one item of animals sold exceeded in value the poultry and eggs.

The eggs produced amounted to 155,710 dozens, and they were worth 29 cents per dozen.

Although products of animal origin form but 2.8 per cent of the farm products of Hawaii, it is well to show the rank held by poultry and eggs, which is done in the following comparative statement:

Sugar	$18,025,515
Rice	1,562,051
Cane sold	729,481
Animals sold	298,476
Coffee	246,181
Taro	177,843
Forest products	125,094
Poultry and eggs	106,803

THE WATER CONTENT OF CREAMERY BUTTER.[a]

By Henry E. Alvord, C. E.,

Chief of the Dairy Division, Bureau of Animal Industry.

Since creamery butter—the product of the factory system—has become the leading grade in the markets of this country, a belief has arisen that it ordinarily holds an undue portion of water. And some have thought that the excess of water was increasing in creamery butter, even to the point of intentional "loading" in exceptional cases. When Great Britain and Germany recently established 16 per cent as the legal maximum for water in butter, it was alleged that the American creamery product would generally exceed this standard; and when, under the new law of Congress concerning "renovated butter," the regulations adopted the 16 per cent limit, manufacturers of this article claimed this to be unfair discrimination, because creamery butter might continue to run beyond this limit, intimating that such large moisture content was usual in the creamery product. No reliable basis existed for such allegations and suggestions, and it seemed desirable to ascertain the facts in this matter.

During the year 1902 the United States Department of Agriculture had opportunities which permitted sampling a large number of packages of creamery butter of known history and direct from the makers. Samples were taken from 730 different packages in all, constituting what may be regarded as a thoroughly representative assortment of creamery butter made in this country. The butter was purchased by the Department for this purpose and other experimental uses. The packages were from 400 different creameries, located in 18 States, and scattered pretty well over the active dairying districts from Maine to California. Nearly half of the butter was made in August, a month when excessive moisture is often feared, and the remainder was produced about equally in the months of May, June, and September. The 802 samples thus taken and submitted to careful chemical tests gave the results shown by the accompanying table.

It is thus seen that the moisture content in the 802 samples examined ranged from 7.2 per cent to 17.6 per cent, with a general average of 11.78 per cent. Butter made in the four months named, considered separately, did not differ much in extremes or in averages. September gave the lowest average of water content and the least range. The averages by months were these: May, 11.81 per cent; June, 11.91 per cent; August, 11.79 per cent; and September, 11.59 per cent. There were only 3 samples found to contain less than 8 per cent of water, only 1 over 17 per cent, and only 8 over 16 per cent. Nearly seven-eighths of the 802 were between 10 and 14 per cent, and considerably more than half between 11 and 13 per cent.

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[a] Published also as Circular No. 39, Bureau of Animal Industry.

Summary of water content in samples of creamery butter.

[Eight hundred samples from 400 creameries in 18 States of the United States, taken in 1902.]

Month in which the butter was made.	No. of tubs sampled.	No. of States represented.	No. of samples analyzed.	Water content.			Classification of samples by water content.									
				Highest.	Lowest.	Average.	Below 8 per cent.	8 to 9 per cent.	9 to 10 per cent.	10 to 11 per cent.	11 to 12 per cent.	12 to 13 per cent.	13 to 14 per cent.	14 to 15 per cent.	15 to 16 per cent.	Above 16 per cent.
				Per cent.	*Per cent.*	*Per cent.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
May	122	18	160	16.40	7.20	11.81	1	4	9	25	58	30	22	9	1	1
June	119	18	119	17.62	8.19	11.91	0	4	11	15	35	32	10	5	4	3
August	377	17	377	16.89	7.23	11.79	2	8	25	61	126	86	47	16	2	4
September	112	18	146	15.28	8.30	11.59	0	1	10	23	48	30	26	6	2	0
Total	730	18	802	17.62	7.20	11.78	3	17	55	124	267	178	105	36	9	8

This is regarded as an unexpectedly good showing for such a large number of typical lots of creamery butter. Great care was taken in the sampling, the treatment of the samples, and the work of making the moisture determinations, with painstaking cross tests for verification at different points; so that the results are deemed reliable. A considerable number of samples (not shown by the table) were rejected because of accidents and manifest faults, and several records of determinations made were also omitted for like reasons. Yet perfection is not claimed, and if error exists at all it is doubtless in giving figures for water content rather below the actual facts than above them. The samples were all taken from tubs smaller than usual in commerce, holding 20 pounds each instead of 60. It is barely possible that the butter thus packed would lose a little more of its moisture than in larger packages, and yet experimental comparisons fail to support this suggestion. On the whole, this series of trials, the most extensive on record in this country, seems to justify the statement that, during the greatest producing half of the year, American creamery butter has an average water content not exceeding 12 per cent. This fact ought to be satisfactory to producers and reassuring to purchasers and consumers.

Several interesting items have been derived from the records incidental to the work described. All of this butter was examined by an expert judge and scored or marked for quality on a scale of points, about the time the samples were taken for examination. All packages marked 95 points or over were considered exceptionally fine, and all marked 85 or lower were the poorest lots, although very fair butter. Twenty samples of butter, taken from one tub in each of the four months from the five creameries averaging the highest scores, all above 95 points, had an average water content for the lot of 11.03 per cent; the best of all, 11.53 per cent. These five creameries were in

Minnesota and Wisconsin. Five of the poorest lots, taken for comparison, gave an average of 10.6 per cent of water. These were from four other States.

The samples with exceptionally low water content were from butter made in August, May, and June, the highest in June and August. The very lowest was May butter and the very highest June butter.

In the September butter the scorer, an experienced and most competent judge, marked eight tubs as showing too much moisture (commercially). Samples from these averaged 12.67 per cent of water. Two packages marked "full of water" had 10.77 and 11.45 per cent (average 11.11), and two marked "worked too dry" had 11.25 and 13.30 per cent (average 12.27). These results show the impossibility of forming any accurate opinion as to actual water content of butter from its appearance alone, even when closely examined by a keen observer.

By way of comparison, the following data are quoted as among the most reliable which are available:

Canadian butter.—During the months of July and August, 1902, officials of the Canadian department of agriculture collected samples from 105 lots of creamery butter, representing the product of five different provinces of the Dominion. The water content of these was determined with the following results: Minimum, 7.94 per cent; maximum, 16.77 per cent; average of 105 samples, 12.31 per cent. These were classified thus:

Between 7 and 8 per cent	1 lot.
Between 8 and 9 per cent	1 lot.
Between 9 and 10 per cent	4 lots.
Between 10 and 11 per cent	15 lots.
Between 11 and 12 per cent	24 lots.
Between 12 and 13 per cent	23 lots.
Between 13 and 14 per cent	24 lots.
Between 14 and 15 per cent	10 lots.
Between 15 and 16 per cent	2 lots.
Between 16 and 17 per cent	1 lot.
Total lots	105

Danish butter (from official reports of butter on the English markets).—2,001 summer samples, average 14.03 per cent; 1,930 winter samples, average 14.41 per cent; average of 8,314 samples, 13.97 per cent of water.

Swedish creameries.—8,340 samples; average 13.57 per cent of water.

American creamery butter (selected from experimental exports by United States Department of Agriculture, 1897-1899).—64 samples; average, 11.03 per cent.

All countries (B. Martiny).—17,332 samples; average, 13.55 per cent of water.

The inquiry into the water content of creamery butter, as above described, was conducted during the year 1902 under the supervision of the Dairy Division, Bureau of Animal Industry. The analytical work was mainly done by the dairy laboratory of the Bureau of Chemistry.

THE DURATION OF THE LIFE OF THE TUBERCLE BACILLUS IN CHEESE.

By F. C. Harrison,
Agricultural College, Guelph, Ontario.

Introductory.—An American student, engaged in advanced bacteriological work in Europe, in the year 1900, made an original investigation as to the life of the germs of tuberculosis when found in cheese. Circumstances caused the study to be mainly with the standard variety of cheese in Switzerland, which is known in the United States under the names Emmenthal, Gruyère, and Switzer-käse. The work attracted much favorable comment by bacteriologists of foremost rank in Europe, who accepted the results as beyond controversy.

The record being published in German only, the author kindly made an English translation at my request. Then, upon the suggestion of a possible doubt as to the applicability of his first conclusions to the Cheddar, or standard American, variety of factory cheese, Professor Harrison repeated his experiments, after his return home, under more satisfactory conditions. His original results were verified, as shown in the report which follows.

Although in portions of the report describing details of procedure the author uses the technical terms of an experimenter in bacteriology, all parts which are of popular interest are given in language free from such terms. The methods followed were those usual in such work. Virulent disease germs of the kind to be studied were separated, identified, and cultivated by themselves. Cheese was specially made into which these living germs of disease were introduced. Particles of the infected material were taken at different dates, as the cheese increased in age and maturity, and injected into the blood or tissues of small animals. Guinea pigs were used in these experiments. The animals were then watched, tested, and examined, to note the results and determine when and to what extent the disease of tuberculosis was thus transmitted to them through the medium of the cheese.

Evidence is thus presented which appears to demonstrate that if milk containing germs of the much-dreaded disease of bovine tuberculosis is made into cheese by the methods most common in this country and the living bacillus thus lodged in the cheese, these germs will all die and become harmless by the time the cheese is properly ripened and ready for use as food. In other words, this investigation shows that there is no danger of taking the living germs of consumption into the human system by eating well-cured cheese of the common kind. It is important to note that the cheese should be at least three months old and preferably four. The same degree of safety does not apply in case of younger and immature cheese, which seems to be growing in favor in some sections. This affords an additional argument for placing upon every cheese the date when made. It is an excellent custom, already practiced by many good makers.

The result of Professor Harrison's work is of great interest and importance to all consumers of cheese, as well as to dealers and manufacturers. By the courtesy of the author the record is now first printed in English and deserves to be widely disseminated.

This publication being intended to give an account of the work and its results for general information, much of the detail of original record which would belong to a strictly scientific report upon such an investigation has been omitted as being needless here.

HENRY E. ALVORD,
Chief of Dairy Division.

WASHINGTON, D. C., *March, 1902.*

REPORT OF PROFESSOR HARRISON'S ORIGINAL EXPERIMENTS IN SWITZERLAND.

[Translated from the German by the author.]

Pathogenic germs, as a rule, have but slight vitality in cheese, but of those which may be present the tubercle bacillus seems to be the most resistant. The large percentage of tuberculous dairy cattle in Europe and even in newer countries makes it important to inquire as to the length of life of the tubercle bacillus in cheese, how often and in what numbers it may be present; what danger there is to the individual who may eat cheese containing the germ, and whether the by-products from the manufacture of such cheese are dangerous to animals fed upon them.

PREVIOUS INVESTIGATIONS IN THE SAME GENERAL FIELD.

If we accept the conclusions of Rabinowitch and Klemperer,[1][a] we must be prepared to acknowledge that, not only the milk of cows having either tubercle in the udder or advanced generalized tuberculosis is dangerous, but also the milk of cows which exhibit no clinical symptoms of the disease, but give the tuberculin reaction. If these results are accepted, a considerable increase must be recognized in the percentage of tuberculous cattle whose milk will be regarded as dangerous or treated as suspicious.

Galtier,[2] in 1887, examined cheese and whey to ascertain what risk of contracting tuberculosis man and animals ran from eating these products. The experiments were made with normal milk tuberculosed by the addition of morbid material taken from diseased phthisical cows killed in the abattoirs or from rabbits which had died from tuberculosis induced by injection. The milk was coagulated by the addition of rennet, and with the cheese and whey thus obtained attempts were made to ascertain the facts as to the transmission of tuberculosis. Unfortunately, Galtier does not state whether the curd was pressed and made into hard cheese or was left without pressure as soft cheese. The inoculations were made into guinea pigs (intraperitoneally) and into rabbits (intravenously). The

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[a] For bibliographic references, see page 233.

particles of cheese were triturated in sterilized water, and the liquid part of the mixture, separated by decantation or filtration, was used for the inoculations. The whey was also filtered before each inoculation, and in this manner the animals were inoculated with cheese and whey of the age of 5, 10, 15, 20, and 30 days, etc. Some of the attempts did not furnish positive results; but the number of cases of undeniable transmission was large enough to establish the preservation of tubercle germs and of the noxious character of the products of the milk which contained them. Galtier obtained "generalized tuberculosis" from cheese not salted and salted, 5, 10, and 15 days old, and from some which was even 2 months and 10 days old. In several experiments, the disease was found in only one-half or one-third of the subjects inoculated; and in other experiments, which were not the most numerous, the results were negative in animals inoculated with cheese 2 months old and even only 15 days old.

The whey, separated from cheese 5, 10, and 15 days before, agitated and filtered before inoculation, invariably gave tuberculosis to guinea pigs, which, however, resisted the inoculation of this product made in doses of 2 c. c.

Like results were obtained with rabbits. Whey 2 days old produced innumerable tubercle lesions in the rabbits inoculated; and the same product, kept for 9 and 16 days, equally produced the disease, but in a slower and milder form.

Finally, cheese 5, 9, 16, and 20 days old, produced authentic tuberculosis in rabbits, from which the germ was subsequently cultivated on artificial media and transmitted to other animals.

From these experiments Galtier concludes that coagulated milk, fresh cheese, and salted cheese, made from the milk of tuberculous cows, may infect man; that the by-products from such milk fed to swine and farmyard fowls may infect these animals; and that it is not irrational to conclude that a certain number of the cases of chicken and swine tuberculosis are due to this cause.

Heim[3] in 1889 also gave attention to this subject. He used cultures of tubercle bacilli grown upon sheep's blood serum. In curd which was mixed with tubercle bacilli he found living germs on the second day (using guinea pigs, injected intraperitoneally) with water-suspended particles of the curd, but none after 14 days.

In curd prepared from milk to which tubercle bacilli had been added, germs were found, even after 14 days, but none after 4 weeks; and also in the whey obtained at the same time, the bacilli were found alive after 14 days.

As may be noted, these results of Galtier's and Heim's differ considerably, the difference being accounted for in part by the different methods of experiment; and for this reason, as well as others, it seemed advisable to make some further investigation as to the duration of the life of the tubercle bacillus in cheese.

DESCRIPTION OF METHODS EMPLOYED IN SWITZERLAND.

While studying at Berne, a series of experiments was planned and conducted as follows:

Cultures used.—The growth from five potato-tube cultures, 4 weeks old, was scraped off and triturated in a sterile mortar with 6 per cent glycerin. To this mass was added the surface growth of tubercle bacilli from 125 c. c. of glycerin bouillon. The whole quantity was ground up as finely as possible and sterilized water (about 200 c. c.) added.

Manufacture of the cheese.—Two cheeses were made in separate vessels and by somewhat different methods, 10 liters, or about 22 pounds, of milk having been used for each. It was intended that these cheeses should, respectively, resemble as nearly as possible the Swiss Emmenthal and American Cheddar varieties. Both lots of milk were heated to 35° C. (95. F.), a portion of the tuberculous emulsion was added to each, and the mixture was thoroughly stirred. One-fifth of one of Hansen's rennet tablets, dissolved in water, was used for each cheese. Five minutes after the addition of the rennet, more of the tubercle emulsion was added, and again after fifteen minutes. The same amount was used for each cheese.

The milk had completely set in thirty-three minutes, and the curd was then cut and stirred with a wire stirrer and left for ten minutes. At the expiration of this time, cheese "A" was heated to 55° to 56° C., and kept constantly stirred for thirty minutes at this temperature, thus following the practice usual in making Emmenthaler cheese. At the end of this time, the curd was transferred to a suitable mold, and a 5-kilogram weight (11 pounds) placed upon it. Cheese "B" was kept stirred for two hours at a temperature of 36° to 38° C. (97° to 100° F.); this was in accordance with the Cheddar cheese method, in which the temperature does not rise above 37° C. (or above 98° F.). On account of lack of the necessary apparatus, other processes usual in making Cheddar cheese were not followed. The curd of this cheese (B) was also transferred to a mold and a 5-kilogram weight placed upon it. After four hours, the weight was increased to 8 kilograms (17½ pounds) on each cheese. The following day the cheese was turned, an operation which was twice repeated. On the second day they were removed from the molds, and salt was rubbed all over them, a thin layer being left on the top. The cheeses were kept at a temperature of about 5° C. (41° F.) for a week, being rubbed with salt and turned every day; at the end of about 10 days they were removed to an empty chest in which the temperature was between 12° and 18° C. (53° to 65° F.). The cheeses were kept free from mold by washing them every second or third day with strong brine for four weeks, after which they were washed only once a week.

Amount of cheese used for injection.—A plug of cheese was removed

with a sterile cork borer, and a varying quantity, drawn from the center of the cheese, was transferred to a sterile mortar. This portion was thoroughly triturated with sterile distilled water or bouillon, and the remainder of the plug was replaced in the cheese.

Injections.—Guinea pigs were used as test animals, and the injections were made subcutaneously near the inguinal region. The first inoculation was very difficult, as the needle of the syringe, although large, became blocked by particles of curd. For subsequent injections the following technique was used, which gave good satisfaction: The animal was fastened to a dissecting board, and the hair was closely clipped over the inner portion of the thigh. This part was then washed with corrosive sublimate, after which a small hole was made in the skin with a large needle, and the end of a glass pipette (freshly made for each inoculation and consequently sterile) filled with the emulsion was introduced and the contents blown in. A pair of pressure forceps, immediately applied to the small hole and held for a few minutes, closed the orifice and prevented the escape of the emulsion.

The average weight of the guinea pigs used in the experiment was 500 grams, or about 18 ounces.

Observations of the animals during life.—The animals were weighed and examined every week; and the presence of tuberculosis was often indicated by the swelling of the inguinal glands and by a gradual loss of weight. At the end of six weeks or longer, .1 c. c. of tuberculin was injected, and in animals badly affected death usually followed in twenty-four hours; but in animals slightly diseased there was a marked rise of temperature, often more than 2° C. In fact, the smaller the amount of tubercle present, the more intense was the reaction. The same dose of tuberculin was often injected into healthy animals, but in no case did the temperature rise 0.4° C. above the normal.

Postmortem.—The postmortem examinations were made shortly after death, and animals not killed by the tuberculin injection were chloroformed and promptly examined. The presence of all lesions was noted. At least three preparations were made from diseased glands and organs, and these were stained by the Ziel Neelsen method.

Results of inoculating guinea pigs with cheese and whey of various ages, to test infection of tubercle bacilli.

EXHIBIT I.—EMMENTHALER CHEESE.

No. of guinea pig.	Age of inoculated cheese.	Quantity of cheese inoculated.	Tuberculin reaction.	Died or killed, and days after inoculation.	Postmortem.	Microscopic examination.	Remarks.
		Grams.	*° C.*				
1	Fresh curd	½	1.7	Died, 52 days	Tubercle in inguinal and retroperitoneal glands, mesentery, spleen, and liver.	Tubercle bacilli in the glands and spleen.	Died 24 hours after injection of 0.1 c. c. tuberculin.
2	7 days	½		Died, 2 days	Muscles dark and infiltrated, edematous fluid.	Bacilli and staphylococci in the fluid.	Cultures and inoculation of rabbits showed *B. coli*, *B. edematis maligni*, and *Staphylococcus albus*.
3	do	½		do	do	do	Do.
4	14 days	½	2.0	Killed, 56 days	Tubercle in inguinal and retroperitoneal glands, liver, and spleen.	Tubercle bacilli in glands and spleen.	Inoculated with 0.1 c. c. tuberculin.
5	do	½	2.2	do	do	do	Do.
6	21 days	½	2.0	Killed, 49 days	Tubercle in inguinal and retroperitoneal glands; spleen slightly affected.	Tubercle bacilli in the glands	Do.
7	do	½	1.9	do	Tubercle in inguinal, retroperitoneal, and mesenteric glands; spleen slightly affected.	do	Do.
8	28 days	¾	1.9	Killed, 59 days	Tubercle in inguinal and retroperitoneal glands.	do	Do.
9	do	¾	1.4	do	do		
10	33 days	¾	2.0	Killed, 64 days	All organs normal; animal in good health; has gained 160 grams since inoculation.	No tubercle bacilli found in either the glands or organs.	Inoculated with 0.1 c. c. tuberculin. A control animal injected with the same quantity of tuberculin gave a reaction of 0.2° C.
11	do	¾	2.3	do	All organs healthy; has gained 230 grams since inoculation.	do	Do.
12	40 days	¾	0.3	Killed, 70 days	All organs and glands normal	No tubercle bacilli	Inoculated with 0.1 c. c. tuberculin.
13	do	¾	0.4	do	do	do	Do.
14	47 days	1	0.2	Killed, 64 days	do	do	Do.
15	do	1	0.4	do	do	do	Do.

16	54 days	1	0.5	Killed, 66 days	do	do	Do.
17	do	1	0.3	do	do	do	Do.
18	63 days	1	0.3	Killed, 58 days	do	do	Do.
19	do	1		Died, 7 days	do	do	
20	70 days	1		Died, 46 days	Intestine strangulated through a hole in the mesentery.	do	
21	do	1	0.4	Killed, 65 days	All organs and glands normal	do	Do.

EXHIBIT II.—CHEDDAR CHEESE.

1	Fresh curd	½	1.2	Died, 45 days	Inguinal, mesenteric, and retroperitoneal glands tuberculous. Tubercle in the spleen.	Tubercle bacilli in all glands	Died 36 hours after injection of 0.05 c. c. tuberculin.
2	7 days	1		Died, 2 days	Muscles dark and infiltrated; edematous fluid.	Large bacillus and staphylococci in the fluid.	Cultures and inoculation of rabbits showed *B. coli*, *B. edemantis maligni*, and *Staphylococcus albus*.
3	do	1		do	do	do	Do.
4	14 days	½		Died, 35 days	Inguinal, retroperitoneal, and mesenteric glands infected; also spleen and liver.	Tubercle bacilli in glands and spleen.	
5	do	½	1.6	Died, 49 days	do	do	Died 24 hours after injection of 0.1 c. c. tuberculin.
6	21 days	½	1.1	Killed, 49 days	Tubercle in inguinal and retroperitoneal glands, spleen, and liver.	do	
7	do	½	1.0	Died, 50 days	do	do	Do.
8	28 days	¾		Died, 56 days	Tubercle in inguinal and retroperitoneal axillary glands, spleen, liver, and lungs.	Tubercle bacilli in glands and liver.	Died 1 hour after injection of 0.1 c. c. tuberculin; was very weak and sick before injection.
9	do	¾	0.9	Killed, 57 days	Tubercle in glands, spleen, liver, and lungs. Tubercles on the peritoneum.	Tubercle bacilli in glands and spleen.	
10	33 days	¾	1.2	Died, 64 days	Tubercle in glands, spleen, and liver.	Tubercle bacilli in glands	Died 24 hours after injection of 0.1 c. c. tuberculin.
11	do	¾		Died, 10 days	Peritonitis	No tubercle bacilli in glands	
12	40 days	¾		Died, 7 days	Very much wasted; large swelling at seat of inoculation.	Cultures from the spleen and microscopic examination showed staphylococcus albus.	Do.

Results of inoculating guinea pigs with cheese and whey of various ages, to test infection of tubercle bacilli—Continued.

EXHIBIT II.—CHEDDAR CHEESE—Continued.

No. of guinea pig.	Age of inoculated cheese.	Quantity of cheese inoculated.	Tuberculin reaction.	Died or killed, and days after inoculation.	Postmortem.	Microscopic examination.	Remarks.
		Grams.	° *C.*				
13	40 days	¼	0.9	Died, 70 days	Tubercle in inguinal and retroperitoneal glands, and in spleen, liver, and lungs.	Tubercle bacilli in glands and liver.	
14	47 days	1	0.9	Died, 64 days	Tubercle in inguinal and retroperitoneal glands, spleen, and liver.	do	Died 24 hours after injection of 0.1 c. c. tuberculin.
15	do	1	0.5	do	do	do	Do.
16	54 days	1		Died, 5 days	Peritonitis		
17	do	1		Died, 64 days	Tubercle in inguinal and retroperitoneal glands, spleen, and liver.	Tubercle bacilli in glands and spleen.	
18	63 days	1	1.1	Died, 57 days	do	Tubercle bacilli in glands and liver.	Do.
19	do	1	0.8	do	do	do	
20	70 days	1	0.8	Died, 65 days	do	Tubercle bacilli in glands	Do.
21	do	1	0.5	do	do	do	Do.
22	77 days	1	0.9	do	Tubercle in inguinal and retroperitoneal glands and spleen.	do	Do.
23	do	1	1.0	do	do	do	Do.
24	84 days	1	1.3	Killed, 40 days	Tubercle in inguinal and retroperitoneal glands.	do	0.1 c. c. tuberculin inoculated.
25	do	1	1.5	do	do	do	Do.
26	104 days	1	2.0	Killed, 70 days	Tuberculosis in inguinal glands	do	Do.
27	do	1	0.3	do	All organs and glands normal; much increase in weight.	No tubercle bacilli	Do.
28	125 days	1	0.4	do	All organs and glands healthy	do	Do.
29	do	1	0.2	do	do	do	Do.
30	132 days	1½	0.2	do	do	do	Do.
31	do	1½	0.5	Killed, 71 days	do	do	Do.

EXHIBIT III.—WHEY.

	Age and kind of whey.	*c. c.*					
1	Whey from cheese A, 4 hours old.	1.5	1.5	Killed, 70 days	Tubercle in inguinal and retroperitoneal glands, spleen, and liver.	Tubercle bacilli in glands and spleen.	0.05 c. c. tuberculin inoculated.
2	Whey from cheese A, 48 hours old.	1.5	1.4	Killed, 49 days	Tubercle in inguinal and retroperitoneal glands and spleen.	Tubercle bacilli in glands	0.1 c. c. tuberculin inoculated.
3	do	1.5	1.7	do	do	do	
4	Whey from cheese B, 4 hours old.	1.5	1.6	Died, 43 days	Tubercle in inguinal and retroperitoneal glands, spleen, and liver; badly infected.	Tubercle bacilli in glands and liver.	0.05 c. c. tuberculin injected; died 24 hours later.
5	Whey from cheese B, 48 hours old.	1.5	1.1	Died, 49 days	Tubercle in inguinal and retroperitoneal glands, spleen, and liver.	do	0.1 c. c. tuberculin inoculated; died 36 hours later.
6	do	1.5	1.4	do	do	do	

EXHIBIT IV.—CREAM CHEESE.

	Kind of cheese.	*Grams.*					
1	Cream cheese	2	1.2	Died, 57 days	Tubercle in inguinal and retroperitoneal glands, spleen, and liver.	Tubercle bacilli in glands and spleen.	0.1 c. c. tuberculin injected; died 36 hours later.
2	do	2	----------	Died, 4 days	do	do	Do.
3	do	2	0.3	Killed, 58 days	All organs and glands normal	No tubercle bacilli	0.1 c. c. tuberculin injected.
4	do	2	0.4	do	do	do	
5	do	2	0.2	do	do	do	Do.
6	do	2	0.2	do	do	do	Do.
7	do	2	1.3	do	Tubercle in inguinal and retroperitoneal glands and spleen.	Tubercle bacilli in glands	Do.
8	do	2	1.2	Killed, 49 days	do		
9	do	2	2.1	Killed, 50 days	Tubercle in inguinal and retroperitoneal glands.	Tubercle bacilli in glands	Do.
10	do	2	2.5	do	do	do	

Results of inoculating guinea pigs with cheese and whey of various ages, to test infection of tubercle bacilli—Continued.

EXHIBIT V.—CHEDDAR CHEESE MADE IN CANADA.

No. of guinea pig.	Age of inoculated cheese.	Quantity of cheese inoculated.	Tuberculin reaction.	Died or killed, and days after inoculation.	Postmortem.	Microscopic examination.	Remarks.
		Grams.	° *C.*				
1	Fresh curd	1	1.9	Died, 70 days	Tuberculosis of inguinal retroperitoneal glands, spleen, and liver.	Tubercle bacilli in glands	Died 18 hours after injection of 0.1 c. c. tuberculin.
2	do	1	1.4	do	do	do	Do.
3	7 days	1.5		Died, 6 days	Peritonitis	Coli infection	
4	do	1.5	1.5	Died, 78 days	Tuberculosis of glands, spleen, and liver; the latter badly infected.	Tubercle bacilli in glands	Died 24 hours after injection of tuberculin.
5	14 days	1.5		Died, 90 days	Tuberculosis of inguinal, retroperitoneal, and mesenteric glands; spleen and liver badly infected.	Tubercle bacilli in liver and retroperitoneal glands.	
6	do	1.5	2.2	Died, 84 days	do	do	Died 18 hours after injection of 0.1 c. c. tuberculin.
7	21 days	1.5		Died, 42 days	Tuberculosis of inguinal, retroperitoneal, and mesenteric glands, spleen, and liver.	Tubercle bacilli in liver	
8	do	1.5	1.4	Died, 63 days	do	Tubercle bacilli in liver and retroperitoneal glands.	Died 28 hours after injection of 0.1 c. c. tuberculin.
9	28 days	1.5		Died, 2 days	Peritonitis; edema	Coli bacteria and a bacillus resembling *B. edematis maligni.*	
10	do	1.5	1.7	Died, 63 days	Tuberculosis of glands, liver, and spleen.	Tubercle bacilli in liver	Do.
11	37 days	2	1.9	Killed, 65 days	Tuberculosis of inguinal and retroperitoneal glands and spleen.	Tubercle bacilli in glands	0.1 c. c. tuberculin injected.
12	do	2	1.6	do	do	do	Do.
13	42 days	2	1.6	Killed, 56 days	do	Tubercle bacilli in retroperitoneal glands.	Do.
14	do	2		Died, 12 days	Streptococcus infection	Streptococci in organs and blood.	

15	52 days	2	1.8	Killed, 63 days	Tuberculosis of inguinal and retroperitoneal glands; spleen slightly infected.	Tubercle bacilli in retroperitoneal glands.	Do.
16	do	2	1.7	do	do	do	Do.
17	62 days	2	1.7	Killed, 67 days	Tuberculosis of inguinal and retroperitoneal glands.	Tubercle bacilli in glands	Do.
18	do	2	1.5	do	Tuberculosis of inguinal glands	No tubercle bacilli	Do.
19	70 days	2	.6	Killed, 70 days	All organs and glands normal and healthy.	do	Do.
20	do	2	.4	do	do	do	Do.
21	80 days	2	.4	Killed, 64 days	do	do	Do.
22	do	2	.3	do	do	do	Do.
23	91 days	2	.4	do	do	do	Do.
24	do	2	.6	do	do	do	Do.
25	102 days	2	.4	Killed, 62 days	do	do	Do.
26	do		.4	do	do	do	Do.
27	112 days		.6	Killed, 82 days	do	do	Do.

If we examine Tables I and II we notice, almost at the first inspection, the difference in the vitality of the germs of tuberculosis taken from the different cheeses. For instance, in the case of guinea pigs inoculated with Emmenthaler cheese 14 days old, the tuberculin reaction was high, the animals did not succumb to the injection, and the post-mortem revealed less disease than was present in animals injected with Cheddar cheese 40 days old; and, compared directly with the animals injected with the latter cheese of the same age, namely, 14 days, the difference was still more marked, the guinea pig dying naturally of the disease, and the other dying from the inoculation with tuberculin. Like results may be noticed from all the succeeding inoculations.

OBSERVATIONS UPON THE RESULTS.

The tubercle bacilli in Emmenthaler cheese were all dead when the cheese was between 33 and 40 days old, for we find that the animals injected with 33-days-old cheese, although they gave a tuberculin reaction of 2° C. and over, showed no signs of the disease at the post-mortem, and both had gained considerably in weight. Cases similar to this have been noticed in tuberculin-tested cattle. Probably, if the inguinal glands from these animals had been transferred to other guinea pigs, the disease might have established itself in the reinjected animals. The animals subsequently injected (40 days, 47 days, etc.) were all free from tubercle and gave no marked tuberculin reaction. Two animals, however, died from other causes.

The tubercle bacilli in the Cheddar-infected cheese were more long-lived, as they continued capable of causing disease up to 104-days-old cheese, at which time one guinea pig had a very slight infection and the other was quite free from tubercle. By a mistake the guinea pigs infected from cheese 111 and 113 days old, respectively, were killed for other work about a month after injection. They were all perfectly healthy; but as they had not been tested for tuberculin, and as sufficient time had not been given for tubercle bacilli to establish themselves, they are not included in Table II. One may, however, safely conclude that the vitality of tubercle bacilli in this cheese did not much, if any, exceed 104 days.

The great difference in the duration of life of the germs in the two cheeses—about 70 days—can be ascribed only to the difference in the method of manufacture. The heat used in making the Emmenthaler cheese (from 50° to 54° C.) and the length of time the curds are kept at this temperature evidently causes the death of the weaker tubercle bacilli and the enfeeblement of the more resistant. The whey from this cheese was also less virulent. Guinea pigs inoculated with it did not die after the tuberculin inoculation, and the post-mortem showed less disease than in those animals inoculated with the same quantity of whey from the Cheddar cheese.

The guinea pigs inoculated with cheese (both kinds) 7 days old all died two days after inoculation, and from these animals the bacillus of malignant edema, as well as *Bacillus coli* and *B. staphylo-albus*, were isolated. I can not believe that the presence of these germs was due to an accidental infection, as exceptional precautions were taken to avoid such complications. At the same time it is remarkable that subsequent inoculations did not show the presence of the bacillus of malignant edema, which, on account of the resistant nature of its spores, one would expect to survive in the cheese for some time. Weigmann has found and cultivated from cheese bacilli similar in morphological character.

The tuberculin reactions which served incidentally for measuring the strength of the tuberculin used have been already mentioned, and the results obtained fully confirm those given by Dönitz. They also served, apart from the post-mortem, to give some idea of the extent of the disease in the guinea pigs, the amount of the disease usually being in inverse ratio to the amount of the reaction. Reference and comparison of Tables I and II will show this very strikingly.

CONCLUSIONS FROM THE ORIGINAL EXPERIMENTS IN SWITZERLAND.

From these results we are safe in concluding that hard cheese—especially Emmenthaler—is quite safe for human food so far as tuberculosis is concerned. Both Cheddar and Emmenthaler are seldom eaten until they are 4 months old or more; at this age all tubercle bacilli which they may have contained will be dead. We should also remember that the number of tubercle bacilli likely to be present in cheese as commonly made is very small, and that in all probability those will die sooner than bacilli put into cheese in the course of experiments like these. Besides this, the original number of such germs in milk will be reduced by being carried off in the whey.

From the experimental data it would seem advisable to use the milk of tuberculous cows, segregated according to Bang's system, for making cheese rather than butter—that is, on the assumption that the latter is made without proper pasteurization of milk or cream. The whey from such milk should be heated to 85° C. (185° F.), which would not only kill any tubercle bacilli that might be present, but would also have other excellent economic results.

EXPERIMENTS WITH WHEY, AND COMMENTS.

The experiments with the whey from cheeses A and B were only to find out if the tubercle bacilli in milk were present in numbers in the whey and if they could live therein for 48 hours, as this is about the limit of time that whey is kept. As has already been remarked, the whey from the Cheddar cheese (B) was more virulent than that from

the Emmenthaler (A), but the latter was also infectious. Ostertag[4] has noted that intestinal tuberculosis is sometimes caused by feeding separator slime to pigs; Galtier has also remarked on the probability of swine and poultry becoming infected with tubercle by eating the by-products of milk; and, in my opinion, this phase of the question is even more important than the human side. At present, outside of Denmark, very little whey is pasteurized, or rather heated to 85° C.; and when we consider the small cost of the operation (as exhaust steam may be used for the purpose) and the benefits to be derived from it, we wonder why it is not done more frequently. In America cheese makers look upon the contamination of milk cans by unpasteurized whey as one of the principal sources of the many troubles met with in making cheese during the summer months. So we have a threefold benefit from heating whey to 85° C.: (1) Destruction of tubercle and other pathogenic bacteria; (2) better keeping of the whey itself; (3) the removal of a prolific source of bacterial contamination of milk cans.

Denmark[5] recognizes the danger of the by-products of milk and has enacted a law which makes compulsory the heating of all such products (whey, skim milk, and buttermilk) to at least 85° C. (185° F.).

TRIALS WITH CREAM CHEESE, AND RESULTS.

As will be noticed in the tables, a few trials were also made with cream cheese. The samples of this variety were bought on the open market in Berne, and the age of some of them was not known; but they all appeared to be only a few days old. Too few samples were examined to warrant the drawing of general conclusions from the experiments. The amount of cheese injected was rather large; and we must remember that a larger proportion of tubercle bacilli is found in cream and in milk sediment than in the milk. Even in the separator many bacilli are thrown out with the cream. So we may expect that a larger number will be found in cream cheese than in ordinary hard cheese. Of the five samples examined, three were found to contain tubercle bacilli—one cheese evidently containing large numbers, if we can judge from the amount of infection. (See guinea pig No. 1, Table IV). The others were only slightly infected.

There is evidently, then, some danger to be apprehended from cheese of this kind—just how much can not be stated. But there is no reason why pasteurized cream should not be used for cream cheeses, because the objections to using pasteurized milk for making hard cheese do not hold in making cream cheese.

NOTE.—The work described herein was done in the bacteriological institute of the University of Berne, and I wish to record my sincere thanks to Dr. de Freudenreich for his kind assistance, interest, and criticism while the work was in progress.—F. C. H.

SUPPLEMENTARY REPORT BASED UPON CHEDDAR CHEESE.

The experiments upon the duration of life of the tubercle bacillus in cheese made at Berne in 1899–1900 (published in the Landwirtschaftlichen Jahrbuch der Schweiz, 1900, and of which the foregoing is a translation), demonstrated that the tubercle bacillus died out between the thirty-third and fortieth days in cheese made after the Emmenthaler method; but in cheese made approximately after the Cheddar method the duration of life of the bacillus was considerably longer.

On account of objections to the imperfect method of manufacture of the Cheddar-like cheese made in Berne, it seemed advisable to repeat the experiment by making a typical Cheddar cheese in a country where such cheese is regularly made. As Russell remarks (Outlines of Dairy Bacteriology):

> Our domestic Swiss cheese, or even cheese of this class made in Germany, rarely have the peculiar flavor that is found in the product imported from the Swiss valleys. For centuries this brand of cheese has been made in that country, until the factories and dairies have become stocked with the right kind of germs, capable of producing the desired fermentation.

If this is true of Swiss cheese manufactured in America, it is likely to be also true of Cheddar cheese made in Switzerland. If added to this objection there is the further one that the details of manufacture of Cheddar cheese made in Switzerland were not identical with the ordinary practice in the making of this cheese, we clearly see that in the interest of scientific accuracy, as well as in the comfort and security that might be obtained from the knowledge of the fact that any tubercle bacilli were likely to be dead before the cheese was ripe and ready to be eaten, it was necessary to carry out another series of experiments upon Cheddar cheese made in the approved manner. This was accordingly done by the writer in the year 1901, and these experiments are first described and reported as follows:

CULTURE.

The culture used was of bovine origin, the seventh transfer since isolation from a tuberculous guinea pig inoculated with a piece of liver from a tuberculous cow. The whole of the growth from 700 c. c. of glycerin bouillon 12 weeks old was used. The growth was very heavy, and on account of the difficulty of separating the masses of bacilli in the pellicle, sterilized powdered glass was used in order to break up the clumps of bacilli, and a fairly good emulsion was thus obtained, which was added to the milk at the same time as the rennet. The infected milk was then stirred constantly for five minutes, when coagulation commenced.

THE CHEESE.

Eighty pounds of milk in good condition were used for making the cheese. The acidity of the milk was 0.14 per cent, and 1½ pounds of a pure culture of a lactic acid baccillus was added, together with 1 dram of cheese color. The milk was set at 86° F., after the rennet test was found to be twenty seconds. Two drams of rennet were used. The other particulars about making this cheese were as follows:

Time between setting and dipping	3 hours.
Time between dipping and milling	2 hours 10 minutes.
Time between milling and salting	1 hour 10 minutes.
Amount of acid at milling	1½ inches.
Amount of salt	3 ounces.
Acidity of curd before salting	8 per cent.
Weight of press on cheese	1,000 pounds.
Weight after cheese was turned	2,000 pounds.

The cheese worked quite normally, the curd having a nice silky feeling and meaty texture. All operations of stirring, etc., were performed with the hands inclosed in a pair of rubber gloves, such as are employed for surgical use, the endeavor being to produce a typical Cheddar cheese, made in exactly the same manner as in a cheese factory.

The cheese was ripened at an average temperature of 60° F., which is regarded as being very suitable for Cheddar cheese, as it does not injure the texture or cause the fat to run out.

With regard to such details as the amount of cheese used for inoculation of the guinea pigs, the method of inoculation, observations of animals during life, autopsy, and microscopic preparations, they were the same as in the Berne experiments; hence it is unnecessary to repeat them.

The acidity of the cheese was tested when a month old. Five grams of cheese and an equal amount of glass were ground together in a mortar; 100 c. c. of water was then added and well mixed with the cheese. After standing fifteen minutes, the mixture was passed through a filter paper. Twenty-five cubic centimeters of the clear filtrate were taken for the determination of the acidity. Phenolphtalein was used as an indicator. The result of this test showed 0.95 per cent acid—figured as lactic acid. A bacteriological analysis was also made at the end of one month; and 1 gram of cheese contained 43,700,000 lactic acid bacteria. No other species were present on the culture plates.

Reference to the table shows that the tubercle bacilli died out somewhere between the sixtieth and sixty-second days. Even previous to the sixty-second day there was evidence to show that the number of living tubercle bacilli was small, or else their virulence was much

weakened, for the guinea pigs inoculated on the forty-second and fifty-second days were all lightly infected.

Three animals were lost from other infection. The one which died after the inoculation of cheese 7 days old may have obtained the infection directly from the cheese, but the other two cases were probably due to other causes.

A comparison of the results obtained from this true Cheddar cheese with the results of the partly simulated Cheddar made at Berne show that considerable difference exists between the two; in fact, a difference of thirty-four days in favor of the genuine Cheddar. There are several probable explanations of this difference. The greater acidity developed in the true Cheddar cheese, both during making and subsequent ripening, must have a certain effect on the tubercle bacilli, and the fact that the salt was directly mixed with the curd, instead of being rubbed on the cheese from the outside and then slowly penetrating inward, would also have some influence. The pressure on the properly made cheese was also much greater, and although this would make no difference to the bacilli present in the cheese, a much closer texture resulted, and this may have had some effect. All three of these factors might together influence and curtail the duration of life of the tubercle bacilli in Cheddar cheese.

CONCLUSIONS VERIFIED AND REPEATED.

These later experiments fully verified the conclusions first reached and justify this statement: If Cheddar cheese, as commonly made in the United States and Canada, happens to contain tubercle bacilli, naturally present, it may be assumed that none of these germs will be living when the cheese becomes ten weeks old; hence no danger need be apprehended of acquiring the disease known as consumption by eating well-cured Cheddar cheese.

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FEEDING FAT INTO MILK;

Or the effect of the food of the cow upon the quality and quantity of milk produced.

[INTRODUCTION.—No question in practical dairying has been more actively discussed in recent years than that of effects of different kinds and quantities of food upon the quality or richness of the milk of the cow. Can fat be fed into milk? Many cow owners of long experience believe that it can, and they give numerous examples where the richness of milk or the quantity of butter produced, has been apparently increased by some special change in feeding or addition of food. And yet the most noted dairy teachers and the experiment-station men and other systematic investigators are practically unanimous on the other side of the question. They agree that although changes of feed may make temporary changes in the fat in milk, the permanent quality of every cow's milk is inherent in the cow herself. A cow bred or born to give rich milk will always give rich milk if she is fairly well fed and treated, with little regard to the kind and character of her food; and if a cow starts out in life by giving milk poor in fat, no method of feeding and no kind of food will materially or permanently change the character of her milk.

This is a very important subject, and for the sake of economical management every dairyman should feel satisfied about it. It is a matter of dollars and cents. The simple fat tests now so well known enable the milk of any cow to be easily tested and its richness positively settled. If it is true that better or different feeding will not permanently improve the richness of milk of a cow which gives a low, unsatisfactory test, it is folly to waste feed upon her attempting the impossible. Owners will be much more willing to dispose of cows proved by test to be giving poor milk, if fully convinced that no treatment will make this milk much better.

It is therefore desirable to place the facts on this live question within the reach of as many owners of dairy cows as possible. Accordingly, two papers upon this subject are herewith republished by permission of their authors. Both present the facts of the case according to the best knowledge of the time, in a fair, clear, and interesting manner. Differing somewhat in method of treatment, they substantially agree, and each supplements the other. Both papers go beyond the relation of food to the quantity and quality of milk, and discuss also the physiology of milk secretion, the physical characteristics of milk, and the effects upon milk production and the milk itself of drugs, nervous excitement, exposure, exercise, fatigue, and other abnormal conditions. Together they treat this general subject of milk secretion comprehensively and in a way which can not fail to be entertaining and instructive to dairymen generally.

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WASHINGTON, D. C., *February, 1902.*]

RECENT EXPERIMENTAL INQUIRY UPON MILK SECRETION.

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To the dairyman, all that is of practical importance in milk secretion centers around the quantity and the quality of the milk. Experimental inquiry has been very active along these lines during the past ten or fifteen years, and the chief embarrassment in attempting a summary of what has been undertaken and the results which have been obtained is the abundance and the variety of the data. The station publications are replete with such results, and in the paper which follows the attempt is made to put in a compact and easily understood form the more important conclusions which have been reached and some of the data upon which they rest. Desirable as it would be to insert references as to the authorities quoted, the limits of a popular paper will not for the most part allow of such reference, and for the most part quotation marks are also omitted.

THE UDDER OF THE COW.

The udder of the cow consists of two glands lying horizontally side by side and separated by a layer of tissues which helps to support them. The glands are distinct from each other, as may be noted by examining the under side of the udder, where the furrow separating them will be found. Each gland ordinarily has two teats on its lower side through which the milk may be drawn from that particular gland. Each of the four teats draws the milk from what is usually termed a "quarter" of the udder. The two teats on the same side of the udder are from the same gland. As the glands are distinct from each other, so in a measure are the quarters. For example, it frequently occurs that cows have garget in one quarter while the other teat from the same gland milks freely and appears healthy.

If an udder be dissected it appears somewhat spongy and pinkish, having numerous holes, or canals, much like a sponge. When cut, milk escapes from the incision. Within each teat is a cavity from which the milk is drawn. At the lower end of each teat a small muscle encircles the outlet to prevent the escape of the milk. Each of the glands of the udder is composed of a quantity of structure somewhat resembling a bunch of grapes. That which may be considered to represent the bunch is called the lobe; the lobule corresponds to one grape, and the alveoli are smaller glands or ducts within the lobule. The alveoli are exceedingly small and can be seen only under a microscope of high power.

The actual secretion of the milk goes on in the alveoli. Exactly how the milk is secreted is not known. It is usually supposed that the process of milk secretion is twofold. That one is a breaking down of the cells in the alveoli which form the fat of the milk, and the

remainder of the process is purely a secretive one, much as saliva is formed in salivary glands. The assumption is sometimes made that in the milk glands of the cow there are as many different and more or less independent forces at work as there are constituents of the milk, and that each of these forces provides for the formation of a single constituent of the milk. A theory which seems to have a greater acceptance at the present time is that the milk glands are possessed of forces which are first of all directed to the formation of milk fat, and the other milk constituents (casein, milk sugar, mineral matters, etc.), occur in a sense as by-products.

Bearing upon the above is the well-known fact that as the period of lactation advances there is a marked diminution in the activity of the milk glands, and this affects the secretion of fat proportionately less than that of the other milk constituents. It is also well known that fluctuation in the regular flow of milk during lactation usually more largely affects the secretion of fat, and it is also frequently observed that to a certain extent the milk yield seems to be determined by the relative tendency of the milk glands to secrete fat.

However the milk may be secreted in the alveoli, it seems to be well established that the milk finds its way through channels of the alveoli into the lobules, and from there into the lobes, and thence into the ducts, where it is conveyed into the milk cistern above the teats.

THE MILK VEINS.

The nervous system of the cow is closely associated with the production of the milk. When the teats are stimulated, either by the hands or the sucking of the calf, the nerves surrounding them become irritated, and through these the nerves of the secreting glands within the udder are excited, causing their contraction and the discharge of their contents. The action of the blood vessels and veins is affected by the activity of the nerves. Ordinarily the greater the capacity of the arteries and veins connected with the udder the larger the milk secretion will be. This shows the importance of securing cows with a strong development of the arteries and veins of the udder and abdomen. An examination of the belly of a good dairy cow reveals thereon, extending from the udder along each side, a milk vein about one-half inch in diameter. The milk veins at the point most distant from the udder pass through what are called the milk wells in the walls of the abdomen. These openings through which the veins pass should be of good size, so as to permit a strong flow of blood through them. As a rule, the greater the milk-secreting power of the cow the larger and more twisted of outline will these veins be.

While experts are able to judge from the general build of a cow much as to her capacity as a milker, the various rules, or "points," which have been laid down for judging the merits of milch cows are of themselves uncertain. While the form of the udder is important,

as also the size of the milk vein, a large, well-formed udder is not always a sign of productiveness.

The best cow in the province of Brandenburg, Germany, as shown in milking trials lasting for a year, was small and unsightly in appearance, and gave no external indication of so great productiveness. While the characteristics of the dairy cow, as regards conformation, temperament, etc., are helpful, intelligent breeders and feeders are exacting from their cows at least a certain yield of milk per year of quality that will assure them a profit in their keeping. The use of the scales and the Babcock milk-fat testing apparatus is of far greater value for determining the capacity of a cow than all the milk "signs" imaginable.

THE NUMBER AND SIZE OF FAT GLOBULES.

The fat is secreted in globular form, and the size of the fat globules in the milk is of great practical importance, since, as a rule, the larger the globules the cleaner will milk skim and cream churn. Studies on the number and size of the globules show that, as a general rule, there is a steady increase in number of the small globules and a decrease in the large globules as the period of lactation advances. From tests made in fractional milking it is learned that there is an increase in the number and size of the fat globules from the beginning to the end of milking.

There is an almost incomprehensible rapidity in the secretion of the globules. Assuming the milk secretion to proceed uniformly throughout the day in the case of 23 cows, each giving a little less than 20 pounds of milk, there was an average secretion of 138,210,000 globules per cow per second. A study of the size of the globules at the Pennsylvania Station showed the relative size of the globules to vary more uniformly with the total yield of milk than with any other factor. In general, a decreased milk production is accompanied by a decrease in the average size of the globules, and an increase in milk production from any cause is accompanied by an increase in the average size of the globules.[a] The influence of the quality and the quantity of food upon the size of the globules appears to be indirect, the real cause being the variation in milk production. If this is true—and the hypothesis is well supported by observations—the method of feeding so as to produce the largest globules is the same as that required to produce the largest possible yield of milk consistent with keeping the cow in a normal condition.

IS THE FAT OF MILK A SECRETION?

Until recently the formation of fat has been commonly regarded as a result of a degeneration or breaking down of the epithelium cells of

[a] This statement needs further investigation and verification before being accepted as a principle or law.—H. E. A.

the gland. It has recently been shown that from the construction of the cells this position is untenable and that the formation of fat is not due to fatty degeneration, but rather to an infiltration of fat which the cells extract from the circulating supply of blood and lymph. The cell secretes, or separates, the fat itself by extracting it out of the fluids furnishing it and no breaking down of the cells takes place. This is not a mere transudation of the fat, as it may be, and usually is, very materially changed in character by the alveoli.

THE REGULARITY OF MILK SECRETION.

With the idea that the fat of milk was the result of breaking down the cells themselves, the thought that milk formation went on more largely at the time of milking than at other times was common. In experiments with Holsteins, Jerseys, Guernseys, and other dairy breeds, when the cows were milked at intervals of twelve hours each, it was found that the weight of milk secreted from 5 p. m. to 5 a. m. was the same as that secreted from 5 a. m. to 5 p. m. The average amount of milk in these trials and its composition are shown in the following table:

	Morning's milk.	Night's milk.
Yield .... pounds..	700	696
Water .... per cent..	86.25	86.39
Solids .... do....	13.75	13.61
Fat .... do....	4.26	4.22

This and similar studies upon the uniformity of milk secretion seem to warrant the belief that the milk is formed continuously and uniformly. The flow of milk at the time of milking is usually much greater than the capacity of the milk cistern, but this is readily accounted for, as the irritation of the nerves causes the contraction of the wall of the glands and milk ducts.

THE SOURCE OF THE FAT OF MILK.

As long as the theory that fat of milk was formed from the fatty degeneration of the milk gland and that it was not a secretion prevailed, it was thought the fat of the milk could not be directly derived from the fat of the food. Many experiments seemed to conform to this view, and it was consequently generally held that the fat of milk was derived from body fat. At the same time it was held by many that the supply of fat in food was always sufficient to more than account for the amount of fat in the milk secreted. The predecessor of the present director of the New York station compared, in the case of a large number of cows, the amount of fat in the milk with that in the food, and concluded therefrom: "It would seem that until strong

proof shall be submitted that the fat of milk is derived from other constituents of the food its source at present must be held as the fat present in the food of the animal."

In experiments with a dog fed in different periods with nitrogenous and carbonaceous rations to which fat treated with iodin was added, it was found that a very considerable amount of the iodin fat was transmitted to the milk. In one case 23 per cent of the fat of the milk was iodin fat, while in a period immediately following, in which no iodin fat was fed, 6 per cent of the milk fat was iodin fat, which must have been derived from the body supply. These experiments indicated that body fat may be drawn upon for the production of milk fat, but that under like conditions the fat is more likely to be derived from the food fat.

By investigation it has been clearly shown that both protein and carbohydrates of food might be the source of body fat. The experiment which seems to indicate clearly that the carbohydrates may also be the source of milk fat was made by the present director of the New York station, and it is so important in its bearing on this question that a quite full abstract of the experiment is here given.

A cow fed during 95 days on a ration from which the fats had been nearly all extracted continued to secrete milk similar to that produced when fed on the same kinds of grain and hay in their normal condition. The yield of milk fat during the 95 days was 62.9 pounds. The food fat eaten during this time was 11.6 pounds, 5.7 only of which was digested; consequently at least 52.7 pounds of the milk fat must have had some source other than the food fat.

The milk fat could not have come from previously stored body fat. This assertion is supported by three considerations: (1) The cow's body could have contained scarcely more than 60 pounds of fat at the beginning of the experiment; (2) she gained 47 pounds in body weight during this period of time with no increase of body nitrogen, and was judged to be a much fatter cow at the end; (3) the formation of this quantity of milk fat from the body fat would have caused a marked condition of emaciation, which, because of an increase in the body weight, would have required the improbable increase in the body of 104 pounds of water and intestinal contents.

During 59 consecutive days, 38.8 pounds of milk fat was secreted and the urine nitrogen was equivalent to 33.3 pounds of protein. According to any accepted method of interpretation, not over 17 pounds of fat could have been produced from this amount of assimilated protein.

As to the source of milk fat, the conclusion is reached that in these experiments the milk fat was produced, in part at least, from carbohydrates, as previous experiments have demonstrated to be the case with body fat.

The quantity of milk solids secreted bore a definite relation neither to the digestible protein eaten nor to the extent of the protein metabolism. The extent of protein assimilation seems to be influenced mainly by the protein supply rather than by the quantity of milk solids secreted.

Neither a deficiency in the protein of the ration nor a depression of the digestible nutrients to about 5.5 pounds per day caused the cow to produce poorer milk. The only apparent effect was in changing the quantity of product. The changes in the proportion of milk solids were due almost wholly to changes in the percentage of milk fat.

THE RELATION OF THE NERVOUS SYSTEM TO MILK PRODUCTION.

Can the brain or nervous system of a cow affect her yield of fat? and, if so, in what ways and to what extent? is the interesting question that has claimed the attention of many investigators. That cows have more or less power to "hold up" their milk is well known, but to what extent they may at will affect the actual secretion is not so clear. A comparison between the amount of milk drawn from a cow by a man and a calf was quite largely in favor of the calf. When cows are milked one teat at a time, both the yield and quality, at least for short periods, are decidedly affected. The yield of fat in such trials fell off from one-fourth to one-third of the yield when milked in the usual way (both teats from the same gland at the same time). Tests made upon these subjects indicate that change of milker, manner of milking, and change of environment all exert a more or less decided influence, temporarily at least, on the quantity and quality of the milk produced, the fat being as a general rule more sensitive to such changes than the other ingredients or the total yield of milk. In tests in which cows were milked in from three to four minutes and double that time, the yield of milk seemed to be very little affected, but in every case richer milk was produced when the cows were milked fast than when they were milked slowly. Many studies, by different investigators, on the effect of the frequency of milking and the studies of fractional milkings, seem to justify the following statements:

The secretion of any single ingredient, such as fat, is not affected by the act of milking.

No considerable formation of milk takes place during milking.[a]

Too frequent milking and allowing the milk to remain in the glands too long both tend to diminish the secretive activity of the glands.

The process of milking in itself is without effect on milk production. Frequent milking, within certain limits, may result in an increased production of milk, not through the act of milking itself, but through the emptying of the glands.

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[a] This statement is still disputed by eminent teachers.—H. E. A.

EFFECTS OF TEMPERATURE AND WEATHER ON MILK SECRETION.

The effect of warm quarters upon milk production is uncertain. In a warm stable there is rather more milk and butter fat, on the average, than in a cold one, but in the climate of New England the increased production will not nearly pay the cost of artificial heating. The most certain effect brought out by these experiments is the lowering of the percentage of fat in the milk in the warm stable. With moderate artificial heat better ventilation can be secured without making the stable too cold for the comfort of its occupants than is possible without artificial heat.

In experiments upon the effect of warming the water used for cows it was found that there was an increase of 5 to 8 per cent in yield of milk and butter fat with water at 70° F. on that at 32° F. On the average more warm water was drank.

From studies upon the effect of weather upon milk production with many animals over long periods of time the following summary fairly represents the case:

There seems to be a general tendency of the quality of the milk to become richer in fat content when the temperature is falling and less rich during a rising temperature.

Concerning the changes in the milk occurring simultaneously with storms, if these changes are considered to be due to the effect of rain storms they seem to indicate that cows in flush of milk on pasture feed give as much or more milk and of just as good quality in bad weather as in fair weather, and that when the storm is over they give a less quantity of richer milk. The cows do not appear to make any change in quantity or quality of milk on the approach of a storm, and no connection is traceable between the storms and the pounds of butter fat produced.

EFFECT OF EXERCISE AND FATIGUE ON MILK PRODUCTION.

It is found that with moderate work (not exceeding two hours a day) the yield of milk is decreased, the decrease being due to a decrease in the water content of the milk, as the milk was more concentrated when the cows were worked. The principal effect is on the percentage and total amount of fat, both of which are increased. There is a decrease in all of the constituents of the solids except the fat, and especially in the case of milk sugar. Seven German experiments are reported in which a number of cows were driven a considerable distance, in some cases up a mountain, and the milk analyzed for a number of days before and after the trip. These experiments were made on different cows, in different parts of the country (Germany), and under varying conditions. They all showed that heavy exercise influenced both the

quantity and quality of milk. The quantity of milk diminished and also the absolute amount of milk constituents. This decrease was more or less noticeable in the first milking after the trip, according to the severity of the exercise, and was much more noticeable in the second milking. The water content decreased in the first milking and more in the second milking, then gradually returned to the normal. The casein content increased in the first milking, remained about the same in the second milking, and then gradually sunk to the normal. The fat content was much increased in the first milking, according to the severity of the trip; was still larger in the second milking, and then gradually sunk to the normal. The sugar content decreased in the first milking and usually rose again to the normal in the second and following milkings. The ash content was noticeably higher in the first milking after the trip, and then sunk to the normal.

In two cases the effects of fatigue are reported where 10 cows were driven 10 miles and shipped 50 miles by railroad. While considerable individual variation was observed on the average, the quantity of milk was lowered as an immediate result, but normal flow was nearly restored by the end of the second day. The fat percentage dropped during the first day and was decidedly increased the second day, remaining a little high during the next few days, as compared with the flow of three weeks later. Solids not fat averaged about the same, except for the second milking. "It seems safe to conclude, as a result of the two tests, that fatigue tends to lessen the milk flow temporarily, to affect variously its quality for the first one or two milkings, and to raise the quality for a while after the second milking."

The above-cited results all agree in pointing out that causes and circumstances affecting the nervous system have marked effects, at least temporarily, on milk secretion. Usually circumstances which affect the animal unpleasantly decrease production. In these cases the fat is the constituent most considerably affected. Most of the experiments upon this class of subjects are of short duration, and there seems to be a tendency under longer continuation of the conditions for the cows to adapt themselves to the change and gradually return to their usual secretion of milk.

COMPOSITION OF AND VARIATIONS IN QUANTITY AND QUALITY OF MILK.

As is well known, milk consists of water, casein, albumen, fat, milk sugar, and mineral matters. The exact amounts of these different constituents in case of different herds and periods of lactation vary within wide limits. As has been stated several times in this paper, the fat is the most variable as well as the most valuable of these constituents. So far as the quantity and quality (as measured by the butter fat) is concerned, the following statements seem to be justified

by observations which have been made with a large number of cows of many herds for numerous periods of lactation.[a]

All cows shrink in quantity of milk as they get farther from calving. If they are farrow, this shrinkage in quantity is accompanied by almost no change in quality, even until they go dry, provided they are still farrow. If they are in calf, the milk increases in quality as it decreases in quantity; this increase is slight, only one-twentieth during the first six months after calving, but becomes quite pronounced just before the cow goes dry.

The milk of a cow for the first few days or weeks after calving is very variable in quality. On the average it is thinned just after calving, becomes slightly richer during the next two weeks, and then holds almost uniform in quality for the next four or five months.

Cows vary in the quality of their milk from one milking to the next and from day to day, the quality rising and falling without apparent cause. Such changes are usually within 1 per cent of fat, but it is probably possible that cases may occur of a doubling in the richness of the milk during different times in the same period of lactation.

The following illustrates the variation in percentage of fat which may occur in the milk of cows from day to day: The morning's and night's milk of a Jersey cow was analyzed on 8 consecutive days, the food, environment, and time of milking being exactly the same each day. The highest percentage of fat found was 5.38 and the lowest 4.45, a difference of 0.87 per cent. The variations which may occur from day to day in the composition of the mixed milk of a herd are illustrated by analyses of the mixed milk of a herd of 13 cows for a period of 32 days. The percentage of fat ranged from 3.63 to 4.59, an average of 4.19, and the amount of fat from 6.48 to 11.78 pounds per day.

Just after calving, the milk is poorer in fat and in solids not fat than just before the cow goes dry. Most cows give about the same quality of milk year after year, beginning with this quality at the first calving. There is no general tendency for the milk to become either richer or poorer as the cow grows older.

From one calving to the next, cows may be expected to vary the general quality of their milk not much more than a sixth of 1 per cent of fat, and scarcely ever will show an average variation of more than a quarter of 1 per cent.

EFFECT OF FOOD ON QUANTITY OF MILK.

There is a unanimity of opinion by practical men and scientific men alike that the food has a great determining effect upon the quantity of milk secreted. Feeding an insufficient ration under otherwise like conditions always decreases the amount of milk secreted. Abundant

[a] A quite full discussion of this subject can be found in the report of the Vermont station for 1895, pp. 157–186.

experiments indicate the importance of maintaining a proper ratio between the flesh-forming (protein) constituents of the food and the energy-producing constituents (the fats and the carbohydrates). The standard prepared by Wolff calls for each 1,000 pounds of live weight 2.5 pounds digestible protein and sufficient digestible carbohydrates and fats, so that the ration shall have a nutritive ratio[a] of 1:5.4. The standard suggested by the Wisconsin Experiment Station calls for 2.15 pounds digestible protein and sufficient fats and carbohydrates to make a nutritive ratio of 1:6.9, and the Storrs Station suggests a ration containing the same amount of digestible protein (2.5 pounds) as the Wolff ration and slightly more digestible fats and carbohydrates, so that the nutritive ratio is 1:5.6. Just what the size of the ratio should be and what its nutritive ratio in order to get the best results is a matter of uncertainty, but that the size of the ration and its nutritive ratio are the determining factors on yield of milk is generally accepted. It seems to be well established also that dry fodders do not give as large a milk flow as succulent foods. At the Halle (Germany) Station it has been found that the milk flow increases regularly with the increase of watery foods until the water is carried above 100 pounds per 1,000 pounds live weight a day. To avoid misunderstanding on this point, it should, perhaps, be added that the results of experiments against feeding meals wet with water ("slops") seem to show decrease in the milk yield without affecting the quality of milk. In the case of cows changed from barn to pasture, it has been repeatedly found that there is a marked increase in milk flow, notwithstanding that most of the herds had grain while in the barn and none while on pasture. The increase which comes when the pastures are dry in the late summer from the feeding of corn fodder is marked and well known. Time and space will not permit a summary of the work along the lines of the effect of food upon the quantity of milk secreted, but the following results are typical of the reports of most exact feeding tests on the subject:

EFFECT OF RATIONS OF VARYING NUTRITIVE RATIOS ON THE SECRETION OF MILK.

The animals were fed in four periods. First the nutritive ratio of 1:8.2, second the nutritive ratio of 1:5.4, third the nutritive ratio of 1:4.3, and fourth the nutritive ratio of 1:8.2, the same as the first. All three rations contained practically the same amount of dry matter and very nearly equal amounts of digestible nonnitrogenous matter. Cows were milked three times daily, and daily analyses were made of the mixed milk of each cow. There was little variation in weight

[a] The nutritive ratio is the ratio of the protein to the fuel constituents of the food, and is found by dividing the sum of the weight of the digestible carbohydrates and two and one-fourth times the weight of the digestible fat by the weight of the digestible protein contained in the ratio.

from day to day. There were no changes in the percentages of fat which could be attributed to changes in the food. In the amount of milk and the total amount of fat there were marked changes.

In the case of each cow the absolute yield of milk and fat increased with the increased protein consumption, this being greatest with the change from the first to the second ration. When the cows were changed back to the wider ration in the fourth period, they all shrunk in the yield of milk and fat.

There was a gain in weight on the rations of the second and third periods, and a loss on that of the fourth period. The results show that it is possible by rich feeding to maintain a yield of milk and fat well up to the end of the period of lactation, and that, on the whole, liberal rations, and especially rations richer in protein than Wolff's standards, were the most advantageous.

LEHMANN'S STANDARD RATION FOR MILCH COWS.

The experiments in this country and abroad seem to indicate that for the production of milk there is need of a liberal proportion of protein in the food. Just why so much protein is necessary physiology is not yet able to clearly explain. It has been suggested that the influence upon milk secretion of an abundant supply of digestible protein in the ration is due to the influence of protein upon metabolic activity rather than because so much is needed to form milk solids. Whatever the explanation, the fact seems fairly well established that a liberal supply of protein is favorable to increase in the amount of milk secreted.

The feeding standard prepared by Wolff thirty years ago was modified by him from time to time in accordance with the teachings of experience and experiment. Recently Dr. Lehmann has made changes in this standard for milch cows so as to provide rations fitted to the actual milk production. In these standards he has made the ration narrower as the amount of milk secreted is larger. The standard rations, as prepared by Dr. Lehmann for cows per 1,000 pounds live weight with different milk yields, are as follows:

Milk per cow per day.	Protein.	Fat.	Carbohydrates.	Nutritive ratio.
Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	
11	1.6	0.3	10	1:6.7
16	2.0	.4	11	1:6.0
22	2.5	.5	13	1:5.7
27	3.3	.8	13	1.4.5

EFFECT OF FOOD ON QUALITY OF MILK.

The question of the effect of food upon the composition of milk has called forth a variety of opinions and much experimental work, and is

at present regarded by many as unsettled. In the opinion of most investigators, after a certain point is passed, food is only of secondary importance, and the quality of the milk depends upon the natural capacity of the animal and the glands for secreting milk. By some investigators and by many practical feeders this point is not considered as settled.

CAN THE PERCENTAGE OF FAT IN MILK BE LOWERED BY SCANTY FEEDING?

In the case of short periods (ten days to three weeks) the results of the experiments seem to be entirely consistent with the conclusion that scant feeding or the feeding of unbalanced rations exerts an entirely insignificant influence on the fat content of milk. The results of all these experiments which have come to my notice are summed up in the following conclusions of one such test:

The animals were fed for two weeks on rations which were insufficient. The cows lost in weight, and in some cases there was a slight shrinkage in yield of milk, but the composition remained practically unchanged, indicating that it is the flesh of the animals that first declines when the aliment is insufficient.

In the case of long-continued, scantily, and poorly balanced feeding, it seems to be clearly established that the fat content of the milk may be materially reduced below the normal. This is illustrated by observation upon cows in Norrland. During the period from January to May, Norrland cows are in general fed only a meager allowance of marsh hay and are therefore in a very poor condition when turned out to pasture in June. The results of about 2,000 analyses for these periods of feeding show that on rich pasturage their milk carried from 2.65 to 5.8 per cent, with an average of 4 per cent of butter fat, and that on scant stable feeding the milk carried from 1.10 to 4.6 per cent, with an average of 3.25 per cent of butter fat. In discussing these results, the author concludes that the fat content of milk can not be increased at will by increasing a normal ration, but, on the other hand, that it can be greatly decreased by scant and poor rations. If a change is made from a deficient to a normal ration, the fat content of the milk will again be raised to the limit determined by the inherent qualities of the individual cow. This point is more or less generally accepted and is of practical importance in the case of ordinary feeding only, as it indicates that cows may be below their normal for some reasons, and that a proper ration may apparently increase the percentage of fat, when in reality it is only bringing the animals up to their normal quality of milk.

CAN THE PERCENTAGE OF FAT BE RAISED BY LIBERAL FEEDING?

Up to the time of the publication of a paper by Soxhlet in 1896 there was little diversity of opinion among American investigators on this

subject. It was generally accepted that the addition of nutrients to an already normal ration would not increase the percentage of solids in the milk or the percentage of one or more of the constituents of the solids. Hundreds of feeding experiments with cows on different rations have been made in which the milk has been analyzed and exact records of the percentages of fat have been kept. These tests have been made with all kinds of feeds and with a very general agreement that changes of feed when cows were previously well fed were without effect on the composition of the milk. The general opinion among investigators, at home and abroad, is illustrated by the following abstracts from the results of feeding experiments in many countries with many animals:

A Danish investigator, speaking of extensive feeding experiments in Denmark, says in substance: The experiments prove that the feed under practical conditions, as found in this country, exerts an entirely insignificant influence on the fat content of the milk.

Another investigator says: The complete chemical analyses of the samples of milk from the different lots failed to disclose any decided difference in the composition of the milk attributable to the different concentrated foods fed, and the author therefore concludes that in the comparative feeding trials with milch cows now continued for seven consecutive years at this station, in which 1,639 cows have been included (separated into 161 lots on 10 estates in different parts of our country), it has been found over and over again that the changes made in the food of the lots have had practically no influence on the chemical composition of the milk. In these experiments grain has been fed against roots, against oil cake, and against wheat bran or shorts; grain and oil cake have been fed against roots, or roots have been fed as an additional food.

An investigator in Scotland, speaking of the results of his experiments, says: These experiments plainly indicate that while many foods appear to have a tendency to enrich or impoverish the milk, still neither effect is permanent, the inclination after a time being for the milk to return to its more normal composition.

The consensus of American investigators on the effect of different rations is illustrated in the discussion of the results of a feeding experiment which may be concisely stated as follows:

About 5 per cent more milk was produced on 2 pounds and 10 per cent more on 2.5 pounds of protein daily than when the animals received 1.5 pounds each. The quality of the milk was scarcely changed.

Such was the situation in 1896, and the subject would have been considered closed, with the evidence all in and verdict rendered, had it not been that in that year a distinguished German investigator published a brief account, without giving the data, of experiments in which the percentage of butter fat was materially increased in milk

by feeding tallow in the form of emulsion. In this paper Professor Soxhlet pointed out that in some of the experiments which have been regarded as conclusive on certain points and which have had much to do with shaping the general opinion of the effect of food on milk, rations were fed which were less digestible than was assumed, *i. e.*, that the particular substances tested, like fat, were added to the basal ration in such form that they were not digested by the animal. Hence, no effect could be reasonably expected. His investigations led him to believe there is no direct transmission of fat from the food to the milk, as some have held, but that normal milk fat is a product of the activity of the lacteal glands, and that its source is the body fat of the cow. The fat of the food affects the secretion of milk fat by replacing a part of the body fat, and thus causes a transmission of the body fat to the milk. He is confident that the fat of the food can effect a one-sided increase in the fat content of the milk; but he states that fat is the only food constituent capable of doing this.

The first brief account of Soxhlet's work is all that has been given, and whether the experiment was confined to one cow and whether the reported increase in yield of fat was continued more than for a few days is not known. As the result of the publication of this experiment a renewed interest was taken in the subject and numerous experiments have been made. While the later findings are not in accord with Soxhlet's results, they are of sufficient interest to warrant a brief review, particularly as they have led to a series of experiments on the effect of fat in food upon butter, which is discussed further on.

Tallow feeding at the New York Cornell Station resulted as follows: Five cows of different ages kept at pasture were fed a ration of equal parts of wheat bran and cotton-seed meal, with the addition of corn-stalks, silage, or hay, when the pasture began to fail. For ten weeks they were given tallow in addition, beginning at the rate of 4 ounces per animal daily, and gradually increasing the amount 4 ounces at a time until each cow was eating 2 pounds daily. Similar experiments were carried out with 5 two-year-old heifers which had recently calved, and a winter trial was also made with 5 two-year-old heifers which had recently calved.

No difficulty was found in getting the animals to eat the tallow. The health of all the animals remained good, and no appreciable change in live weight took place. There was no marked change in the percentage of fat and yield of milk in the period when the cows were on a full feed of tallow. While there are slight variations in the percentage of fat, they rarely reach 0.5 per cent, and, what is of more significance, they are not uniform. Some of the cows gave richer milk and some poorer on a full feed of tallow than they did before or after.

In experiments at the New Hampshire Station the first effect of feeding oils was to increase the fat in the milk. The sharp increase

in fat was followed by a decrease until the milk again reached its normal composition. The results of this work are summarized as follows:

The first effect of an increase of fat in a cow's ration is to increase the percentage of fat in her milk. With the continuation of such a ration the tendency is for the milk to return to its normal condition. The increase in fat is not due to the oils but to the unnatural character of the ration. The results in this experiment tend to confirm the conclusions that the composition of a cow's milk is determined by the individuality of the cow, and that, although an unusual food may disturb for a time the composition of the milk, its effect is not continuous.

The results of German experiments suggested by Soxhlet's results show that the percentage of fat in the cow's milk as a rule increased during the first four to six days of oil feeding, in single cases, nearly 1 per cent; after 10 to 25 days, however, the fat content again became normal in spite of the fact that the oil-emulsion feeding was continued. The yield of milk and of fat changed with the oil feeding in the same manner as the percentage of fat in the milk. Another German investigator finds as the result of experiment that the fat content of the milk was increased at first by feeding large quantities of oil in the form of an emulsion, but later on no increase took place; the milk, on the contrary, dropped to its previous normal fat content, depending on the individuality of the cow.

These experiments, on the whole, indicate that the effect of even very abnormal food materials is not to alter permanently the composition of milk, and one is forced to the conclusion that Soxhlet published prematurely the results of too short experiments. The final conclusions thus far reached indicate that the further addition of nutrients to a normal ration has little or no permanent effect upon the percentage of fat in the milk. The results of these experiments and others of similar kind are making clear the necessity of using long (four weeks or more) feeding periods and the unreliability of conclusions based upon tests of only a few days' duration.

EFFECT OF FOOD ON BUTTER AND THE COMPOSITION OF BUTTER FAT.

The experiment reported upon by Soxhlet which led to the feeding of oils and fats stimulated a study upon the relation of the character of the fat of the food and that of the milk, and tends to throw some light upon the source of the fat of milk.

Investigations by the stations made nearly ten years ago agreed in giving conclusions, of which the following are typical:

The tendency of butter to melt during hot weather may be influenced by the kind of food and also the degree of hardness may be affected.

A mixture of cotton-seed meal or linseed meal with corn meal and

wheat bran, especially the cotton-seed meal mixture, produced butter less easily melted and of a more solid appearance than did the peas and barley.

Gluten products containing large percentages of oil produce soft butter. Gluten meal tends to make soft butter, while cotton-seed meal tends to make a hard butter. The hardness of butter seems to depend more upon the character of the food than upon its nutritive ratio.

The recent feeding of oils and fats as large parts of rations has given results upon the composition of the fat of milk and butter, of which the following are fair illustrations:

Cows fed on cotton-seed oil produce milk the butter fat of which gives cotton-seed oil reactions. The reactions appear when the cows receive only a small quantity of oil. They increase somewhat with continuous feeding, but apparently can not be carried beyond a certain point. The reacting substance passes into the milk within less than twenty-four hours after the feeding begins and continues to do so for several days after it has been dropped.

The same oil had a marked influence on the appearance and taste of the milk and increased the index of refraction, diminished the volatile fatty acids, and increased the iodin number of the butter. The butter produced on cocoanut oil was normal in appearance, but had an unmistakable taste of cocoanut oil. The index of refraction of the butter was materially diminished, the volatile fatty acids were slightly increased, and the iodin number was noticeably diminished. On almond oil the butter showed a positive increase in the index of refraction and the iodin number increased. The authors conclude that the feeding of oils not only greatly changed the butter but that the changes followed in general the characteristics of the oils themselves.

The examinations of the butter fat showed that the volatile fatty acids decreased greatly during the linseed-oil feeding. This effect of the oil feeding was much more persistent than on either the yield or fat content of the milk, and on discontinuance of the oil feeding the return to a normal volatile acid content came but slowly. The iodin number rose and fell rapidly with the feeding of oil and discontinuance of it. As only small quantities of linoleic acid were found in the fat, the increased iodin number must have been due to an increase in the olein content of the fat on oil feeding. The index of refraction changed in the same manner as the iodin number, the curves for the two sets of determinations following each other closer throughout the experiments. The increase due to the oil feeding was very marked and rapid, with the maximum appearing about the fifth day of the oil feeding. The melting point of the fat increased in the same manner as the iodin number—namely, from 35.4° to 39° C.

The above results seem to warrant the general conclusions that when a large quantity of fat is supplied to the animal organism in the food it will, after having been transferred to the blood, be secreted as milk fat, but the secretion can not be looked upon as a direct transmission of the fat from the blood to the milk glands. The fat added will be worked over in passing through the alveoli cells of the milk gland in such a manner that a large amount of olein and a small amount of a fat having a high melting point are formed. If there are large quantities of drying oils in the fat consumed, these will be changed to nondrying oils before being secreted in the milk.

SOME OF THE CONCLUSIONS REACHED.

Although the physiological side of milk production is incompletely understood, and there is need of much investigation before definite statements can positively be made, the results of a present knowledge seem to warrant the following general summary:

The secretion of milk is closely related to the nervous organism of the cow, and anything which affects the nervous system may temporarily affect both the quantity and quality of the milk. Under normal conditions, milk secretion proceeds uniformly during the twenty-four hours. Under usual conditions, the fat of the milk is partly derived from body fat, but chiefly from the fat of the food. The fat is not directly transmitted from the blood, but is modified and worked over by the alveoli of the udder. The quantity of milk is largely determined by the quantity and quality of the food. Under usual conditions the quality of the milk is but little affected by the food. If for any reason the quality of the milk is temporarily changed, there is always a tendency to return to the normal.

When a cow in good condition is in full milk she will give her normal quality of milk at least for a limited time, even though the quality or quantity of her food is deficient.

When in good condition a heavy milking cow will take flesh or fat off her body in order to give her normal quality of milk.

If the food ingredients are present in sufficient quantity, in a state palatable to the animal and easily assimilated, it does not seem to make much difference from what source they come.[a]

The percentage of butter fat in milk is very little influenced by foods containing a large percentage of oil, such as linseed or cotton-cake, nor yet by albuminous foods, such as bean or pea meal, decorticated cotton cake, etc.

The composition of the butter fat is modified within narrow limits by the fat of the food.

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[a] In other words, one kind of food is as good as another, provided there is enough of it and it is well proportioned, or "balanced," and that it is in character satisfactory to the animal.

An increase in quantity and quality of milk over the present normal standard or average product is to be looked for more from breeding than from feeding.

There is a tendency for the milk capacity of the cow to be transmitted to her descendants with usually only small changes in quality and quantity. By proper feeding, the heifer can be developed to her normal quality of milk. How far the quantity may be thus increased is unknown. The hope of improvement of dairy cattle is in wise breeding and in careful selection and judicious feeding of the young stock.

DISCUSSION.

NOTE.—The foregoing paper was read by Professor Woods at an annual meeting of the Connecticut State Board of Agriculture, and was followed by a discussion, from the full report of which the following extracts have been made:

There is a general tendency for the milk to have the same quality throughout the entire history of the animal, from a heifer to old age; that is, the heifer that gives milk of a certain richness will not be apt to vary much from this quality as she increases in age. There may be a very slight increase in the percentage of fat as age advances, but average figures show the whole variation to be only about one-sixth of 1 per cent.

In succeeding generations, improvement in both quantity and quality of milk produced may be expected, resulting not from any one cause but from a combination of judicious breeding, feeding, and treatment.

Secretary T. S. Gold said: "There is one way by which I can reconcile these different statements. The professor says, when you feed a normal ration by adding to it you can improve the quantity and quality of the milk only for a time, but you can not increase it beyond the normal yield permanently. Now, as dairymen, do we not generally allow our cows, in that particular period that has been referred to, just between grass and hay, to live on something below the normal ration—that is, frozen grass and other materials of that kind? And, when we come to give them meal or to put them in the barn and give them good food, we know the product we get is better—better cream and better milk. Half-frozen grass is not a normal ration. A cow will not eat it as well, and, of course, can not be expected to do so well. She never will make first-class milk on such food. It seems to me that Doctor Atwater offered a very suggestive remark in this connection this morning. When our cows are fed on such imperfect rations, do they not require all the nutriment there is in the food for their keep, instead of producing rich milk? The cow grows poor and gives poor milk, consuming the fat in the system. I think we are not so far apart as we might be on this question. I think if we give our cows good normal rations, and they are healthy cows, it will be found difficult to improve the butter or the milk very much."

Ex-Governor W. D. Hoard said: "In Wisconsin we have gone through experiments on this very subject that have cost us over $2,000, to see if we could feed butter fat into the milk or increase the percentage of butter fat. It can not be done. Now, understand that. We will suppose that a cow is giving 4 per cent butter fat in her milk. Can we feed her so that she will give 5 per cent? Many men think so. I have tried it in so many ways that I have given up trying, because it can not be done. I can increase the amount per day, temporarily, of butter fat. I can increase the amount per day, but I have never been able to make any perceptible change in the relation of the solids to each other. For instance, there is 3.5

per cent casein, 4.7 per cent sugar, and 4 per cent of butter fat; and there it stays right along. I have never been able, in all the time that I have been at work at it, to effect any change in the relation of the solid constituents. If it were so, good friends, don't you see it would be very easy to take a Holstein and make a Jersey of it; or very easy to take a Jersey and make a Holstein of it, if you could change the per cent? The percentage is practically fixed. What is the reason, then, that some cows give a richer milk than others? Because they are bred so, and not because they are fed so. At our creamery there have been over 27,000 tests made on milk. We made 12,000 tests at one time in all conceivable ways—chemical analyses, tests of the Babcock apparatus, and all sorts of tests, and I want to tell you what I know. There is a temporary variation sometimes. It passes up and down like the mercury. But, notwithstanding that, I know it is not lasting, because there are certain other causes which change it the other way and change it back to about the normal standard. All sorts of conditions affect the cow's cream—feeding conditions, stabling conditions, etc.—all these things do produce a temporary variation. Some of these things may make a difference in the cows, and hence a change of feed might sometimes stimulate the secretive organs, and you do improve the flavor, and your lactometer will change up and down in the milk, but it is simply temporary. The average percentage remains about the same."

Dr. E. H. Jenkins said: "No one can rationally discuss the result of feeding or the effect of feeding upon butter fat in the milk unless he has weighed the milk from every milking, and unless he has determined the fat either by the Babcock test or by some other laboratory method. An examination of milk, which has been shipped from Litchfield down to New York is not likely to show exactly what the cows give in that locality. I have seen train hands drinking out of the cans, from the cover of the cans, and then filling up the cans with water in such a way as to make the quantity appear correct, and by just so much water as they poured in, the milk was deficient. The lactometer, as the sole test used by the wholesale dealers in New York, shows absolutely nothing as to the contents of the milk. The less fat you have the higher specific gravity you get. This is a subject which can not be discussed in a rational way unless the quantity of milk at each milking is known, and the percentage of fat in that milk shown by the Babcock test, or by some other laboratory test. Now I think that wipes out considerable of this so-called practical knowledge with regard to the effect of feeding on the amount of fat in the milk. If you do not know how much milk a cow gives at every milking—if you do not know the percentage of butter fat in every milking that she gives—there is no use in discussing it at all, because it is impossible to make any rational conclusion."

Professor Woods concluded: "I am not here in the attitude of arguing the matter either one way or the other. The scientific man is simply looking for facts. I take the facts as I find them and report them to you as honestly as I know how; and, as a result of all the observations I have made, I find that it comes down to this: The quality of the milk is something which is inherent in the animal, and is affected by food only within very narrow limits, when affected at all. I am free to admit that there are various things that will temporarily affect the quality of the milk, but I can not imagine that there can be a very radical change in the quality in a change from one kind of food to another food. There may be a temporary change in the quality of the milk, but there is always a tendency of the animal to return to her normal standard, or regular inherent richness."

THE PHYSIOLOGY OF MILK SECRETION.

With notes on the effect of foods, drugs, exposure, exercise, and abnormal bodily condition.[a]

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THE PURPOSE OF MILK SECRETION.

In reproduction among the higher animals, the offspring at birth are not sufficiently matured to be able to subsist alone; neither are they surrounded by food that is already prepared for them. It is therefore necessary that nature should provide for a part or whole dependence upon the mother for subsistence, during such time as is required for development to a state capable of independent existence. As a means to this end, we find a mammary gland in a very large group of animals, the secretion of which is known as milk, and is a perfect food. Milk contains all the nutriment required by a growing body, in proper proportions, in a palatable and easily digestible form. For these reasons persistent efforts have been made to domesticate animals and develop this function to the highest degree as a source of food for people. How successful these attempts have been is exemplified in the milking capacities of several animals now used for this purpose. Animals in a wild state furnish a quantity of milk only sufficient for the young, and only for such time as is necessary for their maintenance. Under domestication the cow in particular has been developed to produce a quantity sufficient to support several offspring and to keep up the secretion almost continuously.

THE MAMMARY GLAND.

The mammary gland being an accessory organ of generation, it is but natural that it should be rudimentary at birth and without function. It remains in this condition until the reproductive function becomes active, at which time it begins to develop quite rapidly and continues to do so until the end of the first period of gestation. Like other organs of the body, it grows with the general growth and also from usage. Its functional activity does not ordinarily begin until near the close of the period of gestation, reaches its maximum at from ten to fifteen days thereafter, and then gradually declines and practically ceases in from six to ten months. If the gland should be examined at birth a white fluid will be found in the ducts, but it is not true milk. True milk may occur, however, at a very early date and without the stimulus of pregnancy. A case, as follows, came under the notice of the writer: A farmer gave a young calf to his son to feed

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[a] Extracts taken by permission from an article in The Creamery Patron's Handbook.

and care for. The little fellow began going through the motions of milking his pet and in the course of a few weeks surprised his father by producing a half pint of milk. While this is an exceptional quantity for a young calf, the observation has frequently been made that small quantities will be present in the udders of calves that suckle each other while being weaned. Gabby reports the case of a heifer that had never shown signs of œstrum suddenly developing a large udder and was milked constantly for three years.

The male is possessed of a rudimentary mammary gland, but the writer is not aware that it ever develops functional activity under any form of stimulus in the lower animals.[a]

THE MILK GLOBULES.

When milk is examined under the microscope it appears as a clear liquid, in which are suspended an immense number of spherical bodies that are of a light yellowish appearance and are highly refractive. These constitute the fatty part of the milk and are known as milk, or fat, globules. Their small size and the viscous nature of the milk serum tend to prevent the coalescence of the globules. The size of these globules varies in all milks from 2 μ up to 30 μ in diameter.[b] The size also varies with the milk drawn, whether it be first, middle, or last drawn, as may be seen by the following records:

Number of globules of each size per 1,000 globules.

Size in μ.	First milk.	Middle milk.	Last milk.	Whole milk.	Skimmed milk.
4	95	18	68	70	365
6	220	90	153	190	425
8	427	215	238	319	120
12	152	443	204	180	54
16	67	180	127	121	24
20	20	54	85	76	12
24	10	0	25	19	....
28	9	0	0	....	....

As the period of lactation advances the globules increase in number and the average size diminishes, so that after several months the total number of globules per cubic centimeter may be two or three times as great as at first, but the size correspondingly smaller; the percentage of fat remains approximately the same.

P. Collier records[c] the results of a large number of determinations of the size of the globules in the milk of different breeds. The size

[a] Bulls of dairy breeds have been known to produce small quantities of milk from the rudimentary teats.—H. E. A.

[b] 1 μ equals 1-25,000 of an inch.

[c] New York Experiment Station Report, 1891.

of the globules diminishes as the period of lactation advances; that is, the relative number of large globules diminishes and the smaller globules increase. He found[a] that the relative number was 100 in the first quarter, 137 in the second quarter, 149 in the third quarter, and 187 in the fourth quarter of the period of lactation; that is, a given quantity of milk contained 89 per cent more fat globules in the last quarter than in the first.

O. Schnellenberger[a] found essentially the same thing, and estimated that a liter of milk contained 2,480,000,000 globules at the beginning and 4,449,000,000 globules at the end of the period of lactation.

F. W. Woll agrees with the previously cited writers, and further adds that age has no apparent effect, and that the morning milk contains more large globules than the evening milk.

The milk from certain breeds, as Jerseys and Guernseys, is characterized by large globules, while that of other breeds, as Ayrshires and Holsteins, usually contains small globules. There is, however, a wide individual difference in all breeds, Jerseys sometimes producing small globules and Holsteins large ones. In normal milk the globules are uniformly distributed throughout the whole mass, but to a greater or less extent collected in groups. For a long time it was thought that each cell was surrounded by its own membrane, the membrane of Acherson. This membrane was supposed to be derived from the cell of protoplasm. According to Babcock, no such membrane exists, and he is supported in this view by nearly all recent investigators. It is now considered that milk is a natural emulsion, and that what appears to be a membrane is not different from what is seen in other emulsions having the fat similarly divided.

QUANTITY AND QUALITY OF MILK SECRETED.

Wild animals secrete only a sufficient quantity of milk to meet the needs of their young until they become sufficiently developed to secure their own food. Under the influence of domestication the functional activity of the gland has been greatly developed both in the quantity produced and in the duration of the period of lactation. In all good dairy cows the period should extend over several months, and in some it is practically continuous. The average yield per cow is less than 4,000 pounds per annum; but in good dairies it is more nearly 6,000 pounds, and in individuals it will greatly exceed that amount. In one instance it was over 30,000 pounds. The flow of milk is greatest shortly after parturition and gradually decreases until the close of lactation.

As milk is dependent upon the metabolism of the mammary gland, this is in turn dependent upon the quantity of blood passing through

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[a] Experiment Station Record, Vol. V, p. 95.

it. For large milking capacity it is necessary that there should be large glandular development; but, more important still, a large circulation of blood in the part. The cow must receive an ample supply of food and have the capacity to eat, digest, assimilate, and turn into blood the elements necessary to form milk. Some time after parturition there is a tendency toward a shrinkage of the vessels of the udder, and this becomes more marked as the period of gestation advances. All the excess nutrition of the body is needed for the developing fetus, and hence a lessening of the functional activity of the gland. That pregnancy is an influence tending to diminish milk secretion is demonstrated by the fact that spayed cows will continue to produce milk a long time, even from two to five years, during which time the quantity and quality make a very gradual decrease. While pregnancy has its influence upon the period of lactation, there are other factors that are of even greater importance and can not be overlooked, the most important of which is the regularity and thoroughness of the emptying of the gland. If the milking process be done at irregular intervals or incompletely, the activity of the gland soon ceases. Shortage of feed or water or disease may result in immediate cessation of secretion. The ordinary period of lactation is from nine to ten months throughout the life of the animal. The first and second periods are somewhat shorter.

The quantity and quality of milk secreted each day is fairly constant. Variations do occur within certain limits and may be due to numerous causes. In general, the evening milk contains about 0.5 per cent more fat than morning milk, but the latter exceeds the former by about 25 per cent in quantity. An attempt has been made to explain this by attributing it to the fall in temperature during the night, requiring some of the fat to keep up the body heat, and to the lessened activity of the animal. Fleischmann and Veith experimented upon a German herd of 119 cows, and found that the fat in the evening milk not only varied within wider limits than in the morning milk, but also observed that from March until July, the period of greatest activity of the gland, that the morning milk was richer in fats than the evening milk. The difference in the quantity of milk drawn morning and evening is due in part to the greater length of time allowed to elapse between the evening and morning milking. This may possibly also account for some of the differences in the percentage of fat. In general, the milk richest in fat is that drawn after the shortest period, and this has been shown to be true in cases where cows have been milked three or four times a day. After a third or fourth week of lactation the percentage of fat in the milk remains nearly constant until the seventh or eighth month or until the quantity of milk begins rapidly to diminish.

The daily variations in the milk are sometimes considerable. Such

variations may be ascribed to changes in the weather, temperature, food, surroundings, indisposition, etc.

The monthly variations in the quantity and quality of the milk are less marked than the daily variations. Cows coming fresh in the spring rapidly better the quality of their milk, beginning about five months after calving, but cows calving in the fall maintain a fairly even quality throughout their entire period of lactation. The quantity of milk is augmented when cattle are first turned out to pasture and during drought, but this must be ascribed to food conditions, and not to seasonal variations. The richest milk is produced after the seventh month.

The yearly changes in quantity are slight. The increase in the second and third producing years is marked, but after that it is rarely more than 3 per cent. The changes are so dependent upon feeding that no conclusions can be drawn upon this point.

FAT IN FORE MILK AND END MILK.

There is considerable difference in the percentage of fat in the milk taken at the different parts of the milking. Schmidt made complete analyses of first milk drawn and last milk drawn, and found that this difference was almost wholly due to the fat, there being eight times more fat in the end milk than in the fore milk. We have made many tests of the fat and found the percentage to be about five times as great in the end milk as in the fore milk. A possible explanation offered for this is that the fat at first lodges or adheres to the lacteal ducts, and that in reality a separation of cream begins in the udder, and this fat would, so far as circumstances permitted, seek to float on the denser fluid in the cisterns and teats. The udder of a cow killed immediately after milking showed on examination that the ducts contained a residue of rich milk, and it is probable that the whole of the fat is never drawn at each milking.

THE ELABORATION OF MILK IN THE ANIMAL ORGANISM.

There has been a large number of theories advanced as to the methods by which milk is elaborated, most of them based upon the assumption that it is a comparatively simple chemical and physical problem. All the earlier theories were based upon such assumption, the physiologists regarding the mammary gland as an organ to separate certain elements from the blood in definite proportions as milk. It was regarded that the process was largely one of transudation through a special membrane, on the same principle that exchange of gases by osmosis occurs rapidly in the tissues of the lungs. It was assumed that the fat of the food and the water and the salts taken into the alimentary canal were absorbed and taken into the blood and then eliminated by the mammary gland. The milk serum was regarded as escaped blood serum, and that the other particles were

derived from the blood or epithelial cells. The gland was assumed to be a semipassive organ, receiving the milk already prepared, and only requiring elimination in the proper proportions.

It was upon the foregoing assumption that the great majority of experiments have been made for the purpose of augmenting the quantity or quality of the milk. If this assumption were correct, then the quantity or quality of milk produced would only be limited by the ability to digest and assimilate food.

Probably the most satisfactorily planned and executed experiment to settle this theory was made by Jordan and Jenter.[a] The object was to determine whether the fat in the milk was derived from the fat in the food. During the entire experiment of fifty-nine days analyses were taken of the feeds and milk, and the urine and feces collected, to determine where everything had gone. For two weeks the cow (a grade Jersey) was fed on 10 pounds of timothy hay, 6 pounds of corn meal, 5 pounds of ground oats, and 1 pound of wheat gluten. Then the same foods were fed with all or very nearly all the fat extracted. For a short time after the change there was a decided variation in the milk solids, but this was soon overcome, and the milk regained its normal composition and maintained it with only slight variations, which could not be assigned to any cause, throughout the entire period. The milk-fat yield for the seventy-five days was 62.9 pounds, and the fat contained in the food 11.6 pounds, of which only 5.7 pounds were digested. The extra fat could not have come from the previously stored body fat, because in the beginning of the experiment the cow was thin in flesh and gained 47 pounds of body weight, and was judged to be a fatter cow at the end than at the beginning. The milk fat could not have come from the protein, because during the fifty-nine consecutive days 38.8 pounds of milk fat was secreted and the urine nitrogen was equal to about 33 pounds of protein. According to any accepted method of interpretation, not over 17 pounds of fat could have been produced from this amount of neutralized protein. For the greater part of the milk fat they could draw no other conclusions than that it is formed, partially at least, from the carbohydrates. Several experimenters have proved that body fat may be formed from carbohydrates, and the foregoing experiment only strengthens the analogy between milk and body fat in this mode of formation. This experiment completely disproves the transudation theory, as the conditions under which it was conducted were wholly under control. It further offers an explanation for the results of many other experiments conducted along the same line but not so completely carried out.

The transudation theory also meets a serious setback in the fact that the fats in the milk are unlike the fats in the food or body, and that casein and milk sugar are not found in the blood or the gland itself.

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[a] Bul. No. 132, New York State Experiment Station.

Another theory that has had many supporters is that milk is the result of the separating of part of its constituents, as the water serum and salt from the blood, and part due to a fatty degeneration of the cells lining the alveolar cavities, the fat globules being due to the degenerated cells and the casein due to the undegenerated portion of the cells. This theory is actively supported by many of the best physiologists. Smith, after examining all the phases of milk secretion, sums up the whole as follows: "The process of milk secretion may therefore be regarded as a process of metabolism of the epithelial cells, which undergo decomposition and discharge the resulting products into the excretory ducts." He regards "fat as a product of fatty degeneration of the protoplasmic cell contents, for it is not increased but actually diminished by an increase of fat in the foods. On the other hand, an increase of proteids in the diet will cause an increase in milk fat. In microscopic examination of the epithelial cells of the mammary gland, oil globules may be actually seen to increase in size and number until often the protoplasmic content becomes almost entirely replaced by oil globules which entirely agree in their characteristics with the oil globules found in milk." In feeding animals on a highly albuminous diet they increase in weight and produce more fat in the milk, at the same time showing that they can not be filling the pail from adipose tissue. However, in herbivora not enough albuminoids are being taken up to account for this fact, so that some must be derived from the blood.

P. Collier made an investigation[a] to determine the number of fat globules found in milk in a given time. He made his observations on a large number of cows and found that on an average each secreted seven-tenths of a pound, or nearly 19.6 cubic inches, of milk per hour, and that there were 152 fat globules in each 0.0001 cubic inch of milk. He concluded that this was equivalent to secreting 136,000,000 fat globules per second. He duplicated his work on 23 other cows and found they secreted an average of 138,200,000 fat globules per second. Collier also recognized the fact that milk contains ingredients that must be the result of some special activity, as the casein and milk sugar are not present in the blood and the fat only in traces, thus precluding the possibility of being derived by transudation. A good cow may produce 2.5 kilograms (5 pounds) of albuminoids, fat, and sugar. The weight of the total solids of a gland producing that amount of milk solids is only about 1.16 kilograms (2.25 pounds), which would necessitate a complete renewal of tissue 2.09 times a day. He might have added that the epithelial cells constitute only a small part of the gland structure, and it would therefore require even more rapid renewal. This would require an almost incredible cell growth, so that we are forced to assume that, although the growth and disappearance of certain cells is of the greatest importance, the organic substances

[a] New York State Experiment Station Report, 1891.

in milk are modified from substances in the blood and lymph into the forms we find them in milk by the functional activity of the cells. The estimates upon the rate of cell multiplication as made by Dr. Collier are only approximate, but are certainly near enough to the truth to warrant drawing the conclusion that fat is not the result of fatty degeneration of the cells. In fact such a process is incompatible with our knowledge of the physiology of the cell reproduction or disintegration.

Soxhlet has recently advanced the theory[a] that milk is the result of the disorganization of tissues, either of the milk glands themselves, according to Voit, or of the white blood corpuscle, according to Rauber. Thus, according to Soxhlet the constituents of food can not be directly converted into components of milk, but must first be used for the construction of some tissue and afterwards be decomposed and then utilized in the production of milk fat. A normal butter fat could then be produced by food devoid of fat, and feeding any kind of food devoid of fat, although rich in fat-forming constituents, would not have the effect of changing the character of the milk fat present in milk. Abundant feeding with nutritive but nonfatty foods could only increase the percentage of decomposing milk tissue. Carbohydrates could contribute to the body fat but not to the milk fat, because they contribute nothing to the milk-producing tissues; but, on the contrary, when fed in conjunction with food poor in protein they diminish the milk fat because the total diminishes the amount of nitrogenous food—that is, substances which produce tissue. It is only fat in food which renders the exclusive increase of milk fat possible by causing a migration of body fat to the milk.

A close examination of the theory, and the explanation given by Soxhlet, shows that it explains many phenomena that could not be explained by the transudation of cell disintegration theories. It must be admitted, however, that it ignores any special constructive power in the gland itself and treats milk as an excretory product.

The latest theory is to regard milk as a product of metabolism of the cells of the mammary gland. It is in all essential characters a secretory product. In viewing the physiology of the formation of milk in such a light, it is only regarding it in the same way as saliva and gastric and pancreatic juices. It may be argued that these glands secrete a special product to be used in the animal economy, while milk is not so used. All excretory glands, as the kidneys, liver, and sweat glands, find their material already prepared in the blood, the result of activity in other parts of the body, and they serve as a means of eliminating it. Secretory glands, as the pancreas, salivary glands, etc., do not find their active principles in the blood, but construct them within their own special cells. The mammary gland does not find fat, casein, and lactose in the blood, but constructs them

[a] Journal Royal Agricultural Society, 3d Ser., Vol. III, pp. 655–662

within its own tissues. The recognition of the mammary gland as an organ having a special function will explain fully all the difficulties met in trying to reconcile all other theories with the facts as they are observed.

The theory of special cell metabolism is supported by the behavior of the gland viewed from an anatomical standpoint. The cells differ when at rest and when active. When at rest the cells lining the alveoli lie flat and close to the wall. Their nuclei are small and spindle-form. During a period of activity they are much enlarged, filling nearly the entire cavity, and the nuclei are prominent. The cells may be seen in all stages of reproduction, and in these particulars the gland shows the same characters as seen in the secreting glands already mentioned.

This theory is further sustained by the antecedents of the milk. When fat is taken into the intestine and assimilated, it no longer has an existence as fat, but is broken up into various combinations. Fat as deposited in the body is not the same as the fat in the food. The proportions of olein and stearin have been changed to meet the peculiarity of the animal. Where the analytic and synthetic process takes place is not known. It is now recognized that it is not necessary that the fat in the body be derived from the fat of the food, but that the carbohydrates supply the necessary materials. With these proofs of synthetic process going on to produce body fat, it is not unreasonable to suppose that a similar process may take place in the formation of milk.

The milk sugar, or lactose, is a product of metabolic activity of the protoplasm of the secreting cells of the mammary gland. This particular form of sugar occurs nowhere else in the body. It is a typical carbohydrate, and is found in the milk of animals fed exclusively upon meat, thus showing that the carbohydrates of the food are wholly unnecessary. Of all the constituents, the milk sugar is least affected by external conditions.

The casein of milk is thought to be formed the same as the fat, although authorities differ on this point. The evidence seems to be in favor of this theory, for at the beginning and at the end of lactation the albumin, which is normally less than one-seventh of the casein, is actually in excess of it, and albumin is a normal constituent of both blood and milk. Smith says casein is developed at the expense of the albuminous cell contents, since it is absent from the blood. The alkali albuminate is derived from the breaking down of the protoplasm and nuclein, which is always found as a part of the casein and is derived from the nucleus which disappears in the process of secretion. The proportion of casein in the milk is increased by greater perfection in the activity of the cells. In the formation of colostrum, the albuminoid matter is greatly in excess of that after secretion is well established, and with the decrease of albumin there

is a proportionate increase in casein. A ferment has been extracted from the mammary gland which will convert albumin into casein.

The water, no doubt, passes directly from the capillaries into the milk follicles, and carries with it the mineral constituents in solution.

The functions of the mammary gland are performed involuntarily. There seems to be some connection between the mammary gland and the central nervous system, but how much control can be exercised by will has not been determined. Locally the stimulus seems to be the empty milk duct, for when the ducts become full the secretion is partially checked, but is considerably stimulated during the process of milking.

INFLUENCES AFFECTING MILK PRODUCTION.

Breed.—Heredity has a most marked effect upon milk production. The different breeds are the result of the selection of animals of certain types, and some have been selected to produce very rich milk, others large quantities of milk, and with others no attention has been paid to this quality. The difference in the quality of milk due to breed includes not only the amount of fat, the color and melting point of the fat, but also the size of the milk globules. In some breeds the globules are large, in some they are small, and in some they may be mixed—large and small. While the breed has a most marked influence, there is also considerable variation of the individuals in each breed.

No figures are available that give a good index to the amount of milk and the period or laçtation in the different breeds of cattle in this country. The only animals of which we have record are individuals, mainly owned by experiment stations or in breeding establishments, which are of more than average quality.

Heredity.—As a breed represents only the characters of individuals fixed by selection for successive generations, it is but natural that we should find like influences in families, but in a less marked degree. Heredity has its effect in stamping individuality, both in the quantity and quality, and no stronger proof is needed than the records of the noted families of the breeds.

Age.—Age will influence the quantity of milk. From 2 until 5 years there is a gradual increase in the quantity, after which time it remains about the same during the periods of activity, until the age of 11 or 12 years, and then it decreases.

Pregnancy.—Pregnancy always has the effect of decreasing the flow, first due to a tendency of the body to take on flesh for a time after conception, and in a later period the nutrition is utilized for the fetus. It is in respect of the period of lactation that individuals show the widest variation. With many the effect of again becoming pregnant is so slight as to be scarcely noticeable, and with others it is so great as to interfere with the usefulness of the animal.

THE INFLUENCE OF FOOD UPON MILK SECRETION.

During the period when physiologists attempted to explain practically all changes upon chemical and physical bases, the teaching was that milk resulted from a separation of its constituent elements from the blood, the separation taking place in the udder. Upon this teaching the belief became fixed that the quantity and quality of the milk secretion was in a measure dependent upon the amount and kind of food the animals received. The influence of this teaching is still potent. Many elaborately planned experiments have been made by individuals and experiment stations to determine the truth or falsity of this view. The results have been very confusing, unless all the data be known. It must be admitted that a large percentage of practical dairymen believe they can take poor or average cows and by good feed and management greatly increase the quantity and better the quality of the milk produced. The results at experiment stations have not been wholly in accord with this view. No doubt but that the dairyman taking a cow in poor condition, scarcely receiving sufficient food to maintain the body nutrition, and giving her good care and abundant feed, will be able to increase both the yield and quality. The experiment station or person who takes an animal in a good state of nutrition and feeds highly may still further increase the flow or maintain it, and may improve the quality for a short time, but not permanently. The error too often committed by the dairyman in drawing a proper conclusion is, first, testing the milk for quantity and quality which is below the normal for the animal because of her impoverished condition, and, second, in drawing the conclusions from the temporary change occurring soon after the change in food. The experiment stations, as a rule, use only well-nourished cattle, and consequently do not find such marked changes, and furthermore they keep the records for a longer period of time, so that the conclusions are not biased by the incomplete data obtained from the temporary changes. Among those who believe that the quality of milk is practically a fixed character in any given individual and not subject to more than temporary variation by the feeding are G. H. Whitcher and S. M. Babcock.[a] The latter sums up the matter as follows: "My opinion is that the quality of milk, so far as it is measured by the percentage of fat, depends almost entirely upon individual peculiarities of the animal, and so long as sufficient food is supplied and consumed, very little depends upon the kind of food. External conditions, which often are not apparent, seem to have a greater influence upon the richness of milk than the kind of feed. This is shown by the fact that the daily variations in the percentage of fat in the milk from the same cow, when no change has been made in the ration, are often greater than occur when a radical change in the food is made."

[a] Rural New Yorker, July 15, 1891.

Furthermore, the same ration will affect different animals differently. According to this theory, the man who endeavors to keep up the standard of his milk by careful feeding can not attain that end, and has no advantage over his neighbor who uses the cheapest ration possible.

According to other writers, as Youatt[a] and Wing,[b] the food has considerable influence upon the quality, but not to the same extent as the quantity. In fact, with cows kept under favorable conditions, with an abundant supply of food, it is hardly possible to increase the proportion of fat to other solids by a change in the food. While the total solids can not be easily affected, the character of the constituents may be influenced, and this is notably so of the fat. For example, linseed meal, gluten meal, and certain other foods make a soft, oily fat, while cotton-seed meal, the seeds of the various legumes, and wheat bran make a hard fat. The constituents other than fat are not so easily affected. When cows are fed on watery herbage, brewers' grains, or other food containing a high percentage of water, the milk becomes poorer in solids. The explanation offered for this last condition is based on the assumption of a more watery character of the blood, due to the excess of water in the food. A poor, watery diet impoverishes the blood and leads to the production of watery milk.

The assumption of a watery diet producing a watery milk is not fully in accord with close observation, as it has been found that the fat content is not diminished by turning cattle from dry feed to pasture. It is in line, however, with the statements so frequently accredited to health boards, that cattle fed on brewers' grains and starch refuse have a lower fat content in the milk than those using dry feeds. My own analyses do not show sufficient difference to be able to decide from the milk test alone which dairy uses sloppy feed and which has dry feed and pasture. The average of a large number of analyses from dairies using slop feed shows about one-half of 1 per cent less fat than dairies using dry feed and pasture. No factor other than food seems to account for the difference.

TIME AND OTHER CONDITIONS ESSENTIAL IN FEEDING EXPERIMENTS.

Typical experiments to determine the effect of food upon the quantity and quality of milk seem to show that some foods have more effect upon milk production than others. In all cases the influence is within narrow limits and can all be accounted for probably by the general effect upon the body, or by one food being more palatable than another and therefore more agreeable to the animal. The effect upon milk is probably no greater than it is upon the body as a whole.

The discrepancy between the results obtained by different experimenters may often be accounted for by the difference in the method

[a] Complete Grazier, 1893. [b] Milk and its products, 1897.

of conducting the experiments. The usual length of time given to each period in a feeding experiment is ten days or two weeks. Many foods have a temporary stimulating effect which naturally shows in such short-period experiments and which would disappear if the period were continued for a longer time.

The duration of the period that should be given to an experiment was also studied at the Vermont Experiment Station. The results there show that the period should be about four weeks in order to make a comparison of quantity and that the period should be six weeks or more in order to get a comparison in quality. This is another evidence of the slow rate at which physiological changes take place in an organ having a fixed habit and also the folly of drawing conclusions from short experiments upon animals.

EFFECTS OF CERTAIN FOODS AND DRUGS.[a]

A great many substances may be transmitted to the milk. The volatile fats that are derived directly from the food may give either desirable or undesirable flavors to the milk. The characteristic flavors we esteem are due to the grasses, clover, and like fodders, while the undesirable are due to leek, garlic, onions, turnips, cabbages, fish, etc. We also find poisonous substances, such as camphor, turpentine, camomile, aloes, arsenic, lead, and tartaric acid, transmitted to the milk. Milk to which aloes, mercury, and copper have been transmitted frequently is injurious. If proper precaution is taken, the undesirable flavors and detrimental effects may be easily obviated, since all these flavoring oils pass off through the excretory channels in a comparatively short time. We shall find them present in the greatest amount, not only in the milk, but in all the tissues of the animal during the time the fodder containing them is undergoing digestion, and by the time digestion is completed the volatile products will have almost entirely passed away. Thus, if care is taken in feeding, so that it will be performed at least eight to ten hours before milking, there will be slight danger of contaminating it. If milking should occur in four or five hours the milk will have an undesirable flavor. Taking advantage of this and feeding the cow immediately before or after, dairymen are often enabled to feed large quantities of turnips and even onions without contamination of the milk. The presence of wild garlic and wild onions in the pasture is a source of bad flavor to the milk. Of course, the remedy here is to remove the wild garlic and onions. It is claimed that placing a small piece of saltpeter in the milking pail will counteract the odor of the turnips. A peck of onions fed to a cow will impart no more odor to the milk than will a small piece of onion added to the milk. Vandenhoydouch[b] reports a case in which milk of all the cows of a village became bitter, although the cows were

[a] Experiment Station Record, Vol. V, p. 973.
[b] Experiment Station Record, Vol. V, p. 971.

healthy. The cows were fed on Swedish turnips which had been washed in foul ditch water. As soon as this was discovered and remedied the milk became all right. Weigmann and Zurn report a case in which the straw used for bedding caused soapy milk. E. Hess, J. Schaffer, and H. Lang have observed the effects of Glauber's salts[a] on some of the cattle of Switzerland. They fed 4 cows, increasing from 40 to 60 grains per head daily, and compared the results with common salt. The cows gave signs of disease of the udder, such as bloody milk, caking, and catarrh. After four days the milk was again normal, but had a taste similar to a weak solution of Glauber's salts. The most striking change in the milk was a decrease in the ability of the casein to be curdled in rennet. The effect of feeding potassium chlorate, according to Bieler, was an increase in the yield of milk at the expense of quality. Cornevin found that pilocarpin increased the sugar from about 0.65 of a gram to 5.5 grams per liter.

Soxhlet[b] has succeeded in demonstrating that butter made from cows fed oil has a melting point of 10° F. higher than normal butter.

EFFECT OF WATER.

There is a popular notion that the more water that a cow can be induced to take into the system the more milk she will yield. To prove this, animals were fed silage two periods, with corn fodder between, and succeeding which corn fodder with silage was used. In every case where there had been a decrease in milk flow there had been a decrease in total amount of water taken into the system, and in every case where there had been a gain in the milk there had been an increase in the amount of water taken into the system. Three cows drank for both silage periods 2,182 pounds of water, and both fodder periods 2,849 pounds of water, but the silage eaten contained 2,489 pounds of water, so that the total water taken during the silage period was 6,226 pounds, while for the fodder period only 5,435 pounds of water. For the silage periods the cows gave 19.07 pounds of milk daily, and the fodder periods 18.51 pounds, showing that during the period in which the greatest quantity of water was taken into the system they gave the most milk in return. It is also shown that as the period of lactation advances, the amount of decrease of water taken into the system and the amount of milk produced are almost exactly in the same proportion; that is, the decrease of water taken in during the second silage period was 19 per cent of the amount in the first, while the milk decreased 20 per cent.

In the fodder period, the second shows a decrease of 14 per cent of water and 13 per cent of milk over the first period, while in all the periods the decrease of 14 per cent of water and 13 per cent of milk occurred from the first.

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[a] Experiment Station Record, Vol. V, p. 971.

[b] Journal Royal Agricultural Society, 3d ser., Vol. III, p. 655–662.

That this is not chance, but characteristic of cows, will appear from a study of the experiment made during three years at the Wisconsin Experiment Station.[a] In seven out of eight tests the cows took more water into the system daily and gave more milk while eating silage than on corn fodder, and in the other cases the amounts were equal, thus showing that the rations which produced the most milk contained the most water. When silage was fed with water at 39° F. there were 2.9 pounds of water drank for each pound of milk yielded.

Two experiments were conducted at the Wisconsin Experiment Station to ascertain the effect of the temperature of the water on the milk production. One experiment lasted for sixty-four days and the other one for sixty days. There were six cows used in each test. One lot was given water at a temperature of 32° F., and the other at 70° F. In the first experiment the time was divided into three periods of sixteen days each, with intervals between them. At the close of these periods the water temperatures were reversed—that is, the cows which received water at 32° F. were given water at 70° F., and vice versa. The warm water gave the best results, making 1,002 pounds more of milk per day. The cows ate more while on warm water than on the cold. The fat content was about the same in the samples of the different milk.

It is an interesting fact that a cow in full flow of milk requires from one-fourth to one-third more water than when she is not giving milk, and a cow giving a large quantity of milk requires more than one not giving so much. Cows not giving milk require from 70 to 80 pounds daily upon dry feed, and from 100 to 120 pounds daily when giving milk.

THE EFFECT OF CHANGE IN TEMPERATURE AND STORMS.

The effect of sudden change in temperature seems to affect the secretion of milk in an indirect manner through the nervous system. It would be but natural to expect that some effect would be noticed either upon the quantity or quality or both. An examination of the milk in butter-fat record of the cow Early Morn at the Indiana Station for one year fails to show any connection between the quantity and quality of her milk and the condition of the weather. In fact, her greatest variations occurred at times when the weather was stationary. It may be remarked in this case that this might be due in part to the unusual good protection which she received.

The study made upon the effect of temperature at the Vermont Experiment Station and its results seem to show that the effect of temperature upon the quality of milk is an inverse one, that almost two-thirds, or exactly 61 per cent, of the changes in quality, were in

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[a] Wisconsin Agricultural Experiment Station. Bul. No. 21, and Reports 1889–1890.

opposite directions to the changes in temperature. During the period under observation there were 31 changes of temperature—17 rising, 10 falling, 4 stationary. On fifteen of the days, when the weather became warmer, the fat in the milk decreased, and as the weather became cooler the fat increased. The tendency of this would seem to be that the milk became richer when the temperature was falling and less rich during the rising temperature. In the test in 1892 there were 55 chances for comparing the effect of changing temperature upon the percentage of fat in milk, and 33 to test the effect on the percentage of total solids. There were 22 cases of rising, 21 of falling, and 12 of stationary noon temperature. During the twenty-one days the fat percentage in night's milk changed in opposite direction to the temperature, during eighteen it changed in the same direction, and in four cases there was no change in fat percentage, thus confirming the former test. The total solids were found to rise and fall in much the same way as the fat. During the thirty-three days of the first half of the test, in which the calculations of the solids were made, there were fourteen days of rising, twelve of falling, and seven of stationary noon temperature. On fifteen days the percentage of total solids in the night milk varied inversely, on seven days the changes were in the same direction, and there were four cases of no change. A little more than two-thirds (68 per cent) of the changes were in the opposite direction to the temperature changes. In the experiments the changes in the inverse direction were more decided than those in the same direction.

During the test made in 1891 by the Vermont Experiment Station[a] there were several heavy storms. The amount of milk delivered immediately following these was larger than just before. The quality of milk can not be said to vary much in any direction, but the milk of the second morning after the storm was less in quantity and richer in quality than before. The amount of this disturbance was not in accord with the severity of the storm. The cows do not appear to have made any change in the quantity or quality of the milk on the approach of the storm, and no connection is traceable between the storms and pounds of butter produced. Observations after 60 storms show that after 7 there was diminished quantity and after 3 there was no change.[b]

In experiments conducted at this station (Indiana) in 1893, milch cows exposed to the weather in the winter, but provided with night shelter, made a very unfavorable showing as compared with those given shelter in the stable excepting for brief airing when the weather was suitable. The exposed cows ate more food, lost in weight, and also in milk yield, while the sheltered ones gained in weight and made

[a] Vermont Agricultural Experiment Station, Report 1891.

[b] Bul. No. 30, Nebraska Agr. Exp. Station, C. L. Ingersoll and H. B. Duncanson.

a better showing. At the Kansas Experiment Station similar results were obtained.

REGULARITY AND UNIFORMITY OF MILKING.

While the process of milk secretion is a continuous one, it is not entirely uniform, for, as is generally believed, the rate of secretion is increased greatly while milking. Again, in proof of this the distention of the milk ducts and reservoirs by milk already present acts as a check upon secretion. In all cases the udder becomes unduly distended with milk between milkings, and an increased flow will be secured by milking off the milk. The time of milking should be regular, for a difference of an hour will frequently make a difference of 10 per cent in the amount secreted, and if the irregularities are frequent a diminished flow will result. The amount given is also considerably affected by the way in which the milk is drawn. In general, it may be said that rapid milking is conducive to a large flow. At all times the milk should be drawn so that no discomfort is caused to the animal, and in this respect there is a great difference among milkers. A rapid, uniform stroke, with a firm touch of the teat and a stroking motion of the lower part of the udder gives the best results. Babcock has found that certain milkers get not only more milk than others from the same cow but that it is richer.

The Vermont Experiment Station undertook to demonstrate[a] the fact that fast milking is more advantageous than slow. In so doing, 8 cows were used in the experiment—4 full milkers and 4 strippers. The slow milking took more than twice as long as the rapid milking. The experiment proved two things: First, the diminution in the milk flow from one period to another; second, essentially unchanged quality. All the cows gave less when milked slowly, although in three cases the difference was but slight.

Two cows milked every hour for seventy-two hours gained both in quantity and percentage of fat. The gain the first day was much greater than afterwards.[b]

H. H. Dean tried milking diagonal teats[c] to see if there would be an increase in the milk production. With one cow there was no difference; with another, less milk was given. F. Albert tried a similar experiment and found that by milking the quarters or diagonal teats there was a marked increase in the quantity. He was so sure of his conclusions that he strongly recommends that this method of milking be always followed.

Dr. E. L. Sturtevant had the different quarters of the udder of a cow milked separately a number of times and the milk weighed and the total solids and fat determined. He found a marked difference

[a] Vermont Experiment Station, Report of 1891, p. 55.
[b] Bull. No. 9, New Hampshire Agr. Exp. Sta., G. H. Whitcher.
[c] Experiment Station Record, Vol. V, p. 965.

in the quality of the milk from different quarters of the udder. Dr. Babcock made a similiar experiment along the same lines and reported that, for any single milking, the results fully confirmed those of Dr. Sturtevant and showed a decided difference in the quality of the milk from different teats. If, however, the whole series be considered, it is evident that the order in which the teats are milked is the chief factor which affects the quality of the milk. Dr. Babcock says in conclusion: "It is doubtful about there being any difference in the physiological function of the different quarters of the udder." At the Indiana Experiment Station like experiments were conducted with the same results. At the North Carolina Station cows milked one teat at a time showed a less percentage of fat than those milked as usual.[a]

EFFECT OF EXERCISE.

Though locomotion is detrimental to the yield of milk, it is a mistake to suppose that uninterrupted confinement in the stall is the most economical treatment for a milch cow. With moderate locomotive exercise the slight reduction in quantity of milk appears to be fully compensated by the increased yield of solids. Munk undertook to settle this point, and experimented with 30 cows and found that when they were allowed half an hour daily exercise the total quantity of the milk, as well as the fat and casein, increased, though much exercise exerted an adverse influence on the yield. When cows are on grass their increased appetites in the presence of an abundance of food quite makes up for any loss incurred in the movement necessary to obtain that food. Hence it is desirable that stall-fed milch cows should have daily exercise. Very violent exercise sometimes has the effect of producing very much change in the quality as well as the quantity. It always has the effect of lessening the quantity, but the effect upon chemical composition is not known. There are numerous instances, however, in which the physiological effect of taking milk from an exhausted animal has proven injurious. It is generally recognized among farmers that it is unsafe to allow a calf or colt to suckle when the dam is overheated.

EFFECT OF CHANGE OF LOCATION.

The effect of a change of quarters on the quantity and quality of milk was experimented upon by the Vermont Station. The herd was milked, and then driven 3½ miles to new quarters. Composite samples were taken of the milk of 7 cows for 4 milkings before and after the change. Six and one-tenth per cent larger yields of milk ingredients followed the change. Babcock found in a similar experiment a falling off in both quantity and quality, but the increase of the succeeding

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[a] Bull. No. 116, North Carolina Agr. Exp. Sta., F. E. Emery.

days more than compensated for the decrease. A change in the stable routine, as feeding out of order or at irregular times, may have like effect.[a]

EFFECT OF NERVOUSNESS.

Both the secretion and the excretion of the milk are under the control of the nervous system, but the exact mode whereby the nervous influence is exerted remains to be worked out. Indirectly, however, the secretion of milk must largely be affected through the sympathetic nervous system, whose center is a chain of nervous element extending along the general body cavity just beneath the backbone. The nerves act by controlling the caliber of the blood vessels, and thus regulating the blood going to the udder. It is a well-established fact that anxiety of the mother, caused by removal of the young, as well as by sudden fear—all chance excitement of any kind—will cause a partial and sometimes a complete suppression of the milk secretion. Not only is the amount of milk secreted affected by the nervous state of the animal, but its composition is also changed, even when the quantity remains the same. Unkind treatment of the cow, willful or otherwise, is found to show its effects in diminishing the yields of milk. Ill ventilated, badly drained, or too-drafty cow houses, careless exposure in bad weather, irregular feeding, brutal usage, fast driving, the mad rushing about provoked by the attacks of the ox warble fly, and a variety of other causes are bound to exert an influence upon the nerves, the effect of which will be certainly recorded in the milk pail. At the Vermont Station[b] a test was made of dairy cows at home and at the fair ground to determine the effect of the nervous excitement on the milk flow. The results indicate that the tendency of nervous excitement is to lessen the quantity of milk and variously to affect the quality, according to the individuality of the animal, the fat being the most variable ingredient. In general, the activity of the animal and the nervous excitement decreases the flow of milk, stall-fed animals producing more than grazing animals.[c]

EFFECT OF RAGE, FRIGHT, AND SUDDEN SHOCKS.

On August 12, 1892, at Lake City, Fla., the following case occurred: A fine cow owned by Mrs. T. had a healthy calf four days old at her side. The cow was of a very nervous temperament, and particularly averse to dogs. Upon the night of that date a dog strayed into the stall next to the cow and calf. The cow made frantic efforts to get at the dog, and was in a state of excitement for six hours. The calf

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[a] Bul. No. 116, North Carolina Exp. Sta., F. E. Emery.

[b] Vermont Experiment Station, Report 1895.

[c] There are numerous authentic records of a marked decrease in the percentage of fat as the result of nervous excitement.—H. E. A.

remained quiet and unharmed and suckled soon after the dog went away. Three days after the calf died.

Another case occurred August 10, 1891, at Bourbon, Ind. A valuable mare was owned by Mr. C. She had a foal six weeks old. The day was very hot, and the mare was used at the harrow and the colt left in the shade. The mare fretted greatly and was worked a couple of hours longer than usual to finish a piece of work. The foal was allowed to suckle as soon as work was stopped. It died in about four hours. No cause could be assigned except the possibility of the milk having become altered both by fretting and heat.

It has also been observed that after sheep have been frightened or worried by dogs a number of lambs may die which have in no way been disturbed or injured by the dogs. In such cases the milk has seemed to be the cause of the trouble.

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STATISTICS OF OLEOMARGARINE, OLEO OIL, AND FILLED CHEESE, 1900 TO 1902.

Compiled by R. A. PEARSON, M. S.,
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All the available statistics relating to the production and distribution of oleomargarine, oleo oil, and filled cheese which might be of public interest, were published in tables in the Sixteenth Annual Report (1899) of the Bureau of Animal Industry, together with the requirements of the United States laws and special references to the statistical data of chief importance. With one or two exceptions, the latest figures included were for the fiscal year ended June 30, 1899. In the Eighteenth Report of this Bureau the same statistics were carried forward to include the next two years. For convenience of reference and comparison the same data is now repeated, with additions to the end of the fiscal year of 1901–2. And the tables are so arranged that the present publication, in connection with that first above mentioned, covers the subject completely to date. The sources of information are the same as before, being the Bureau of Internal Revenue and the Bureau of Statistics of the Treasury Department. A part not yet published has been kindly furnished through the Division of Foreign Markets of this Department.

OLEOMARGARINE.

The largest output of oleomargarine in any fiscal year since the oleomargarine revenue law took effect in 1886 was during the twelve months ended June 30, 1902, and amounted to 126,316,436 pounds, an average of 10,526,370 pounds per month. This was an increase of about 18 per cent over the production in 1900, 120 per cent over that of 1898, and 177 per cent over the product of 1897. The revenue collections from oleomargarine in 1902 were $2,944,492.46. The production decreased very slightly in 1901, but increased again in 1902. As in earlier years, the greater part of the output in 1902 was for home consumption, the exports amounting to less than 3 per cent of the production. (Table I.)

Statistics of production and distribution of oleomargarine by months have not been published by the Treasury Department, but by special courtesy they have been furnished to this Bureau (Table II), and it is noted that quantities produced in different months varied about as in the years preceding 1902, with the exception that in April and June there was a decided increase.

The manufacturers of oleomargarine in 1900 and 1901 were located in the same States as in 1899, with the addition of Kentucky and Texas, which appeared on the list of producing States for the first time, and Pennsylvania, which had not been on the list since 1895; in 1902 Colorado was added to the list. Illinois continues to stand far in advance of all others in quantity manufactured, having turned out, in 1902, 49,883,015 pounds, or about 40 per cent of the total production of the country. In 1901, 42,331,822 pounds, or 40 per cent of the total, and in 1900, 46,417,148, or 43 per cent of the total production. Ohio has risen to second place, with a production in 1902 of 21,161,743 pounds. Kansas, which was second in 1900 and 1901, falls to third place in 1902, when the output was 20,189,299 pounds. Rhode Island (in the Connecticut district) and Indiana occupy fourth and fifth places. Their production increased to about 10,000,000 pounds in 1900 and 1901, and to about 12,000,000 pounds in 1902. The Maryland district output (including the District of Columbia, which is the important part in this connection) was more than doubled from 1899 to 1900, increased still further in 1901, and in 1902 was about six times what it was in 1899. New Jersey's production was much larger in 1900 than in 1899, and in 1902 was nearly twice as large as in 1900. In 1900 a little more than 300,000 pounds of oleomargarine was produced in the western part of Pennsylvania, and this was increased to over 2,500,000 pounds in 1902. Small amounts were made in Kentucky and Texas in 1900, and increased from two to five fold in 1901 and 1902. The production of Missouri in 1900 amounted to 4,032,442 pounds, but decreased in 1902 to 74,380 pounds.

Rhode Island is the principal source of oleomargarine which is withdrawn for export, having furnished 2,687,810 pounds in 1901 and 2,349,224 pounds for this purpose in 1902, or nearly five-sevenths of the total amount withdrawn for export; most of the balance went from Illinois, New Jersey, and Kansas. (Tables III and IV.)

As would be expected, the number of establishments engaged in the manufacture and sale of oleomargarine considerably increased in the years 1900, 1901, and 1902. There were over twice as many manufacturers, wholesalers, and retailers in 1902 as in 1899, the numbers being in 1902, 35, 192, and 10,821, respectively. Manufacturers were located in 1902 in ten States and the District of Columbia.

Wholesalers were located in the District of Columbia and 34 States and Territories, Hawaii being a recent addition to the list. Retailers were located in the District of Columbia and every State and Territory except seven, namely, California, Nevada, Utah, Vermont, Washington, Wyoming, and Hawaii. In Illinois were 2,907 retailers in 1902, and 1,935 in Ohio, Ohio's increase being remarkably rapid, having had 953 in 1899 and 513 in 1898. In 1902 New Jersey had the third largest number of retailers, 733, having increased from 259 in 1899. Missouri was next with 609 retailers, the number in 1899

having been 222. Indiana had 589 retailers in 1902 and 292 in 1899. Michigan increased from 152 in 1899 to 420 in 1901, but decreased to 301 in 1902. West Virginia increased from 171 to 489 and Virginia from 109 to 293. The most notable decreases in numbers of retailers from 1899 to 1902 were in Pennsylvania, where the number fell from 721 to 321; Minnesota, from 25 to 4; Nebraska, from 90 to 48; New Hampshire, from 13 to 5, and North Dakota from 18 to 8. (Table IV.)

The quantities of oleomargarine sold in different States are not regularly reported, but such information was furnished for the year 1899 in compliance with a special resolution of Congress and was included in an article on this subject issued by the Department of Agriculture. In that article it was shown that the amounts of oleomargarine disposed of in the different States are roughly indicated by the numbers of retail dealers. On this basis Illinois would still stand at the head of the list, but Pennsylvania, instead of being second, would be preceded by Ohio, New Jersey, and perhaps a few other States.

The revenue turned into the United States Treasury from the various taxes upon oleomargarine is, of course, proportionate to the total output. In 1902 the gross receipts were $2,944,492.46, of which about four-fifths, or a little less than $2,500,000, came from the tax of 2 cents on each pound manufactured for domestic use. The remainder is from taxes upon manufacturers, wholesalers, and retailers. (Table V.)

Only 0.86 per cent of the internal revenue raised in 1900 came from oleomargarine, 0.82 per cent in 1901 and 1.08 per cent in 1902.

The export of oleomargarine is very light, 5,721,254 pounds went out in the fiscal year 1902, 4,990,699 pounds in 1901, and only 4,256,067 in 1900, against 5,549,322 pounds in 1899. In 1902, 62 per cent of the exports went from the customs district of New York, about 20 per cent from Philadelphia, and 15 per cent from Baltimore; the remainder from the several other districts. (Table VI.)

There is no uniformity in monthly exports, the quantity depending upon many changeable conditions. In the year ended June 30, 1902, the months of largest export were January, 956,907 pounds; February, 587,951 pounds, and March, 796,496 pounds, the smallest export months being June, 266,125; November, 339,318 pounds; and December, 318,338 pounds. In the preceding year the largest monthly exports were in February, April, and May, and the smallest in July, September, and October. (Table VII.)

The West Indies continue to furnish the chief outlet for exported oleomargarine. Those islands took nearly half of the quantities sent out in the fiscal years 1900, 1901, and 1902. To the British West Indies were shipped, in 1902, 1,353,324 pounds, which was a little more than in the preceding year. The amount sent to Cuba is rapidly increasing, being 777,534 pounds in 1902, compared with 157,706

pounds in 1899. Trade is apparently being pushed also in Haiti, where 216,280 pounds was shipped in 1902, more than eight times the quantity in 1899 and four times that of 1900. To Belgium was sent 106,365 pounds in 1902, nearly twice as much as in 1900. Netherlands in 1902 took 743,275 pounds.

There is a decided falling off in the exports of oleomargarine to the French West Indies, the amount credited to that destination in 1902 being 129,614 pounds. In the same year 113,975 pounds was sent to the Danish West Indies. The quantity sent to Porto Rico in 1900 is given as 219,140 pounds, and none in 1901 or 1902. To Germany there was exported, in 1902, 997,655 pounds of oleomargarine, which was a large decrease from the quantity in 1901, although twice as much as that in 1900. To the United Kingdom only 131,292 pounds was sent in 1902, a little more than one-third of the quantity of 1900. Newfoundland and Labrador, to which no oleomargarine was exported in 1898 or 1899, took 107,473 pounds in 1900, none in 1901, and 153,646 pounds in 1902. Shipments to British South Africa amounted to 237,738 pounds in 1901 and 106,762 pounds in 1902. In 1900, 118,396 pounds was credited to Hawaii, but none since then. To Mexico there was sent, in 1900, 9,194 pounds, and in 1902, 46,790 pounds. Besides the instances already mentioned, there has been a marked decrease in the exports to the British East Indies, while none was exported to Sweden and Norway in 1902. (Table VIII.)

OLEO OIL.

The exports of oleo oil amounted to 146,739,681 pounds in 1900, 161,651,413 pounds in 1901, and 138,546,088 pounds in 1902. More than 70 per cent of this went from the New York customs district. Baltimore, Philadelphia, and Boston were important points of export. (Table IX.) The exports in the spring and summer months are generally a little larger than in the other seasons, but in 1901 they were larger during the summer and fall months. (Table X.)

As in previous years, Netherlands furnished the principal outlet, taking 68,884,209 pounds in the fiscal year of 1902—nearly one-half of the total amount exported. The exports to Germany fell off more than 6,000,000 pounds from 1901 to 1902, the amount in 1902 being almost the same as that in 1900. Shipments to Denmark have shown a large increase during the past three years, the quantity credited to this country in 1902 being 12,933,733 pounds. Exports of oleo oil to Quebec, Ontario, etc., have increased to over 800,000 pounds. Shipments to Austria-Hungary appear to have commenced only recently. They amounted to nearly 1,000,000 pounds in 1899, were 676,625 pounds in 1901, and fell to 339,546 pounds in 1902. Shipments to Italy were practically nothing in 1900, but amounted to 617,947 in 1901 and 2,243,550 pounds in 1902. Decreases are reported in the exports to Nova Scotia and New Brunswick. (Table XI.)

FILLED CHEESE.

The production of filled cheese decreased in 1900 and 1901. The output in the latter year was 1,305,459 pounds, being the smallest reported since the revenue law took effect, in 1896. Practically all of the output was for export. The total revenue receipts from this article in 1901 were $14,652.64. In 1902 no filled cheese was produced. (Table XII.)

As in previous years, the production of filled cheese in 1900 and 1901 was discontinued during a large part of the warm season, and was largest in the winter months. The maximum monthly production in the two years ended June 30, 1901, was 319,846 pounds in April, 1900. Most of the filled cheese was exported; in fact, for a period of nineteen months ended November, 1899, none was withdrawn for domestic use but in December of 1899 its withdrawal was resumed, and little less than 50,000 pounds went into use in this country in that month and the five following. From June to December, 1900, there were no withdrawals for domestic use. They commenced again in January, 1901, and in five months amounted to a little over 50,000 pounds. (Table XIII.)

In 1901 only 8 establishments were reported to be handling filled cheese. Five were manufactories in Illinois, and 2 were retail establishments in the Maryland district and 1 in the Louisiana district. (Tables XIV and XV.)

TABLE I.—*Production and distribution of oleomargarine and total revenue receipts therefrom, 1897 to 1902.*

Fiscal year ended June 30—	Quantity produced.	Withdrawn, tax paid.[a]	Withdrawn for export.[b]	Received, all sources.
	Pounds.	*Pounds.*	*Pounds.*	*Dollars.*
1897	45,531,293	42,508,469	3,148,407	1,034,129.60
1898	57,516,136	55,079,887	2,259,705	1,315,708.54
1899	83,139,901	79,701,108	3,095,738	1,956,618.56
1900	107,045,028	103,616,142	3,376,764	2,543,785.18
1901	104,943,856	101,432,717	3,507,193	2,518,101.44
1902	126,316,436	123,567,325	3,469,199	2,944,492.46
Total for six years	524,492,650	505,905,658	18,857,006	12,312,835.78
Total since November 1, 1886[c]	985,905,796	944,968,950	39,795,493	23,948,480.51

[a] Two cents per pound.
[b] Without tax.
[c] Date when oleomargarine revenue law took effect.

TABLE II.—*Monthly production and distribution of oleomargarine, 1900 to 1902.*

Year and month.	Quantity produced.	Withdrawn, tax paid.	Withdrawn for export.	Lost or destroyed.
1899.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
July	5,082,768	5,668,111	232,187	....
August	7,165,520	6,829,625	352,027	....
September	9,004,412	8,548,614	255,409	....
October	9,939,198	9,548,318	259,750	....
November	11,006,430	10,456,645	254,397	....
December	10,635,969	10,187,591	218,148	....
1900.				
January	10,495,705	10,080,212	242,247	....
February	9,853,370	9,750,396	308,419	....
March	10,841,485	10,706,494	349,257	4,019
April	8,331,454	8,279,597	197,338	2,900
May	7,398,463	7,214,623	357,179	7,500
June	6,570,224	6,345,916	350,406	56
Total	107,045,028	103,616,142	3,376,764	14,475
1900.				
July	6,374,471	5,803,465	289,085	....
August	7,162,022	6,906,231	235,027	939
September	8,267,931	7,926,891	204,004	19,775
October	10,089,192	9,553,808	306,092	....
November	10,296 097	10,172,816	341,483	....
December	10,245,500	9,642,932	295,092	....
1901.				
January	10,172,946	10,072,223	322,069	....
February	8,991,326	8,581,747	267,861	100
March	9,166,371	8,935,583	269,641	750
April	9,506,852	9,291,479	322,746	32,899
May	8,190,183	8,333,653	343,623	....
June	6,480,965	6,211,889	310,470	44,555
Total	104,943,856	101,432,717	3,507,193	99,018
1901.				
July	6,982,388	6,675,314	369,071	....
August	9,200,917	8,593,700	370,324	....
September	9,315,208	8,967,619	195,578	....
October	9,534,599	9,201,140	327,778	....
November	10,059,010	9,691,436	279,464	....
December	10,492,592	10,277,949	254,021	....
1902.				
January	10,531,629	10,118,825	304,148	....
February	10,064,518	9,672,768	266,350	....
March	11,308,969	11,160,341	343,552	....
April	14,082,226	13,523,404	326,705	....
May	10,154,741	9,654,772	286,900	....
June	14,589,640	16,030,067	145,308	....
Total	126,316,437	123,567,335	3,469,199	....

TABLE III.—*Production and distribution of oleomargarine, by districts, 1900 to 1902.*

Internal-revenue districts.	Produced.	Withdrawn, tax paid.	Withdrawn for export.	Lost or destroyed.	Remaining in factory June 30.
Year ended June 30, 1900.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Connecticut [a]	10,448,162	7,796,902	2,653,214		56,292
First Illinois	46,248,446	45,834,089	475,269		359,526
Thirteenth Illinois	168,732	165,623			4,109
Sixth Indiana	10,778,599	10,737,649	9,200		121,418
Kansas [b]	16,686,460	16,392,323	229,781		156,928
Fifth Kentucky	76,125	72,569			3,500
Maryland [c]	2,207,748	2,202,390			7,447
Sixth Missouri	4,107,696	4,118,273			3,210
First New Jersey	604,279	595,849	9,300		8,050
Fifth New Jersey	115,300	115,300			
Eleventh Ohio	12,464,249	12,459,902			66,376
Eighteenth Ohio	2,734,214	2,739,898			16,386
Twenty-third Pennsylvania	301,153	281,485			14,564
Third Texas	103,890	103,890			
Total	107,045,028	103,616,142	3,376,764		817,806
Year ended June 30, 1901.					
Connecticut [a]	10,786,496	8,085,968	2,687,810		49,235
First Illinois	42,273,236	41,571,302	668,259		350,902
Thirteenth Illinois	58,556	60,549			
Sixth Indiana	9,143,286	9,184,200	13,989		66,659
Kansas [b]	16,365,738	16,246,090	135,444		141,808
Fifth Kentucky	165,133	160,630			8,003
Maryland [c]	2,670,218	2,676,404			
Sixth Missouri	4,032,442	4,000,807			
First New Jersey	144,275	151,425	900		
Fifth New Jersey	308,591	307,791	800		
First Ohio	1,098,503	1,073,354			25,139
Eleventh Ohio	12,739,370	12,775,313			30,433
Eighteenth Ohio	2,606,100	2,606,257			16,229
Twenty-third Pennsylvania	2,157,052	2,137,787			33,829
Third Texas	394,830	394,830			
Total	104,943,856	101,432,717	3,507,193		722,237
Year ended June 30, 1902.					
Colorado	38,039	38,039			
Connecticut [a]	12,886,762	10,583,773	2,349,224		
First Illinois	49,680,881	49,472,199	570,584		
Thirteenth Illinois	193,134	191,274		1,860	
Sixth Indiana	11,244,920	11,294,087	17,522		
Kansas [b]	20,189,299	20,179,649	151,928		
Fifth Kentucky	304,894	312,887			
Maryland [c]	6,159,376	6,159,376			
First Missouri	74,380	74,380			
Fifth New Jersey	1,287,349	913,212	375,187		
First Ohio	4,175,790	4,196,620	4,804		
Tenth Ohio	8,726	8,726			

[a] Including the State of Rhode Island. No oleomargarine was manufactured in the State of Connecticut.

[b] Including Indian Territory and the Territory of Oklahoma, but no oleomargarine was manufactured in either of these Territories.

[c] Includes Delaware, District of Columbia, and two counties of Virginia.

TABLE III.—*Production and distribution of oleomargarine, etc.*—Continued.

Internal-revenue districts.	Produced.	Withdrawn, tax paid.	Withdrawn for export.	Lost or destroyed.	Remaining in factory June 30.
Year ended June 30, 1902—Continued.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Eleventh Ohio	14,570,824	14,610,057			
Eighteenth Ohio	2,406,403	2,406,623			
Twenty-third Pennsylvania	2,510,781	2,544,580			
Third Texas	575,878	575,586		292	
Total	126,316,436	123,564,068	3,469,249	2,152	

TABLE IV.—*Number of manufacturers, wholesalers, and retailers of oleomargarine in each State and Territory, 1900 to 1902.*

[This table shows the number of establishments which paid taxes in the years named. The numbers vary slightly from the numbers actually in business, as taxes are sometimes paid before or after the year to which they apply.]

States and Territories.	For year ended June 30—								
	1900.			1901.			1902.		
	Manufacturers.	Wholesalers.	Retailers.	Manufacturers.	Wholesalers.	Retailers.	Manufacturers.	Wholesalers.	Retailers.
Alabama		3	20		3	39		5	74
Alaska			12			2			3
Arizona		2	11		1	5			4
Arkansas		1	57		1	46		1	61
California									
Colorado		7	151		7	151	1	6	165
Connecticut			7			10			19
Delaware			57		2	50		1	46
District of Columbia	2	3	43	2	3	30	2	4	49
Florida		6	102		7	109		7	126
Georgia		7	86		7	94		6	116
Hawaii					2	1		2	
Idaho		1	4			6			3
Illinois	7	23	2,691	10	21	2,891	10	19	2,907
Indiana	4	4	419	4	7	469	3	6	589
Indian Territory			25			31			63
Iowa		1	3						2
Kansas	2	1	201	3	4	193	3	2	214
Kentucky	1	3	299	2	2	316	2	2	329
Louisiana		5	176		5	284		6	246
Maine			24			9			7
Maryland		11	112		6	96		6	90
Massachusetts		9	100		3	82		4	67
Michigan		15	376		8	420		3	301
Minnesota		11	25		12	9		1	4
Mississippi		1	23		1	16		1	16
Missouri	1	2	332	1	4	404		8	609
Montana						1			5
Nebraska		4	62		3	63		3	48
Nevada									
New Hampshire		5	26		1	3		2	5
New Jersey	2	9	455	2	8	630	2	11	733

TABLE IV.—*Number of manufacturers, wholesalers, etc.*—Continued.

States and Territories.	For year ended June 30— 1900. Manufacturers.	1900. Wholesalers.	1900. Retailers.	1901. Manufacturers.	1901. Wholesalers.	1901. Retailers.	1902. Manufacturers.	1902. Wholesalers.	1902. Retailers.
New Mexico	....	1	21	....	....	17	....	1	24
New York	....	....	11	....	2	11	....	....	20
North Carolina	....	....	26	....	1	37	....	1	75
North Dakota	....	....	8	....	....	7	....	....	8
Ohio	3	15	1,439	3	16	1,699	4	18	1,935
Oklahoma	....	1	12	....	....	19	....	1	71
Oregon	....	....	2	....	....	3	....	1	4
Pennsylvania	1	15	587	1	15	376	1	11	321
Rhode Island	3	4	316	3	5	315	5	6	330
Sonth Carolina	....	2	51	....	3	54	....	3	68
South Dakota	....	....	8	....	....	5	....	....	3
Tennessee	....	2	94	....	5	85	....	3	98
Texas	1	15	139	1	16	132	2	16	159
Utah	....	....	....	....	....	....	....	....	....
Vermont	....	1	3	....	....	1	....	....	....
Virginia	....	4	180	....	2	236	....	7	293
Washington	....	....	2	....	....	2	....	....	....
West Virginia	....	5	237	......	9	354	....	12	489
Wisconsin	....	4	20	....	2	18	....	6	22
Wyoming	....	....	13	....	....	18	....	....	....
Total	27	203	9,068	32	194	9,849	35	192	10,821
Number of States and Territories in which located	11	36	47	11	34	48	11	35	45

TABLE V.—*Internal-revenue receipts from oleomargarine, by districts, 1900 to 1902.*

Internal-revenue districts.	Collections on oleomargarine at 2 cents per pound.	Special taxes of— Manufacturers.	Special taxes of— Wholesale dealers.	Special taxes of— Retail dealers.	Total.
Fiscal year ended June 30, 1900.					
Alabama	....	....	$880.00	$692.00	$1,572.00
Arkansas	$296.00	....	786.00	1,770.00	2,852.00
Colorado [a]	....	....	2,600.00	6,236.00	8,836.00
Connecticut [b]	159,651.56	$1,800.00	1,960.00	14,182.00	177,593.56
Florida	....	....	1,580.00	4,098.00	5,678.00
Georgia	....	....	2,640.00	2,802.00	5,442.00
First Illinois	923,378.40	3,400.00	6,840.00	90,812.00	1,024,430.40
Fifth Illinois	....	....	2,280.00	4,130.00	6,410.00
Eighth Illinois	....	....	....	4,708.00	4,708.00
Thirteenth Illinois	3,308.76	300.00	1,140.00	2,962.00	7,710.78
Sixth Indiana	214,083.62	1,450.00	1,796.00	11,060.00	228,389.62
Seventh Indiana	....	....	....	4,024.00	4,024.00
Third Iowa	....	600.00	....	....	600.00
Fourth Iowa	....	....	....	116.00	116.00
Kansas [c]	329,662.94	2,400.00	360.00	8,988.00	341,410.94

[a] Colorado includes Wyoming.
[b] Connecticut includes Rhode Island.
[c] Kansas includes Indian Territory and Oklahoma.

TABLE V.—*Internal-revenue receipts from oleomargarine, etc.*—Continued.

Internal-revenue districts.	Collections on oleomargarine at 2 cents per pound.	Special taxes of— Manufacturers.	Wholesale dealers.	Retail dealers.	Total.
Fiscal year ended June 30, 1900—Con.					
Second Kentucky				$530.00	$530.00
Fifth Kentucky	$1,478.10	$350.00	$840.00	7,376.00	10,044.10
Sixth Kentucky				2,588.00	2,588.00
Seventh Kentucky				828.00	828.00
Eighth Kentucky				36.00	36.00
Louisiana [a]			5,160.00	8,516.00	13,676.00
Maryland [b]	44,074.42	1,000.00	7,060.00	6,554.00	58,688.42
Massachusetts			3,880.00	4,638.00	8,518.00
First Michigan	470.12		1,800.00	5,890.00	8,160.12
Fourth Michigan			4,480.00	6,922.00	11,402.00
Minnesota			4,200.00	904.00	5,104.00
First Missouri			840.00	9,836.00	10,676.00
Sixth Missouri	82,002.00	600.00		2,972.00	85,574.00
Montana [c]			1,140.00	156.00	1,296.00
Nebraska [d]			2,240.00	2,910.00	5,150.00
New Hampshire [e]			7,102.36	2,354.00	9,456.36
First New Jersey	11,920.98	600.00		2,640.00	15,160.98
Fifth New Jersey	2,326.56	250.00	3,420.00	13,832.00	19,828.56
New Mexico [f]			880.00	1,012.00	1,892.00
First New York				206.00	206.00
Second New York				48.00	48.00
Third New York				138.00	138.00
Twenty-first New York				48.00	48.00
Twenty-eighth New York				54.00	54.00
Fourth North Carolina				832.00	832.00
Fifth North Carolina				216.00	216.00
First Ohio			3,040.00	11,030.00	14,070.00
Tenth Ohio			1,600.00	7,472.00	9,072.00
Eleventh Ohio	249,286.66	1,000.00	680.00	18,020.00	268,986.66
Eighteenth Ohio	54,659.26	600.00	2,120.00	19,808.00	77,187.26
Oregon [g]				386.00	386.00
First Pennsylvania			2,880.00	5,328.00	8,208.00
Ninth Pennsylvania				320.00	320.00
Twelfth Pennsylvania			1,145.00	1,564.00	2,709.00
Twenty-third Pennsylvania	5,776.64	200.00	4,500.00	15,474.00	25,950.64
South Carolina			960.00	1,968.00	2,928.00
Second Tennessee	72.00			808.17	880.17
Fifth Tennessee			760.00	3,304.00	4,064.00
Third Texas	2,825.00	900.00	5,840.00	4,618.00	14,183.00
Fourth Texas			3,210.00	1,356.00	4,566.00
Second Virginia			1,060.00	4,492.00	5,552.00
Sixth Virginia				1,052.63	1,052.63
West Virginia			2,240.00	8,662.00	10,902.00
First Wisconsin			900.00	618.00	1,518.00
Second Wisconsin			1,080.00	246.00	1,326.00
Total	2,085,273.02	15,450.00	97,919.36	345,142.80	2,543,785.18

[a] Louisiana includes Mississippi.
[b] Maryland includes Delaware, District of Columbia, and two counties of Virginia.
[c] Montana includes Idaho and Utah.
[d] Nebraska includes North and South Dakota.
[e] New Hampshire includes Maine and Vermont.
[f] New Mexico includes Nevada.
[g] Oregon includes Alaska and Washington.

TABLE V.—*Internal-revenue receipts from oleomargarine, etc.*—Continued.

Internal-revenue districts.	Collections on oleomargarine at 2 cents per pound.	Special taxes of— Manufacturers.	Special taxes of— Wholesale dealers.	Special taxes of— Retail dealers.	Total.
Fiscal year ended June 30, 1901.					
Alabama			$1,040.00	$1,190.00	$2,230.00
Arkansas			480.00	1,870.55	2,350.55
Colorado [a]			2,500.00	5,178.00	7,678.00
Connecticut [b]	$163,087.70	$1,800.00	1,840.00	12,682.00	179,409.70
Florida			3,960.00	3,682.00	7,642.00
Georgia			3,360.00	3,076.00	6,436.00
Hawaii	96.00		880.00	48.00	1,024.00
First Illinois	831,004.13	6,200.00	5,240.00	110,066.50	952,510.63
Fifth Illinois			1,560.00	5,248.00	6,808.00
Eighth Illinois			560.00	5,644.00	6,204.00
Thirteenth Illinois	1,201.60	600.00	1,120.00	3,212.00	6,133.60
Sixth Indiana	184,447.02	1,875.00	3,080.00	13,634.00	203,036.02
Seventh Indiana				4,000.00	4,000.000
Kansas [c]	327,209.68	1,100.00	2,720.00	8,694.00	339,723.68
Second Kentucky				656.00	656.00
Fifth Kentucky	3,245.60	700.00	960.00	8,028.00	12,933.60
Sixth Kentucky				2,508.00	2,508.00
Seventh Kentucky				650.00	650.00
Eighth Kentucky				84.00	84.00
Louisiana [d]			4,160.00	8,332.00	12,492.00
Maryland [e]	53,661.10	1,200.00	4,560.00	6,270.00	65,691.10
Massachusetts			2,684.52	3,620.00	6,304.52
First Michigan			1,240.00	8,064.00	9,304.00
Fourth Michigan			1,420.00	7,176.00	8,596.00
Minnesota			3,760.00	276.00	4,036.00
First Missouri			1,380.00	13,734.00	15,114.00
Sixth Missouri	79,927.90			2,544.00	82,471.90
Montana [f]			720.00	246.00	966.00
Nebraska [g]			1,440.00	3,038.00	4,478.00
New Hampshire [h]			480.00	434.00	914.00
First New Jersey	3,012.50			4,356.00	7,368.50
Fifth New Jersey	6,167.62	600.00	3,280.00	20,992.00	31,039.62
New Mexico [i]			480.00	1,024.20	1,504.20
First New York				120.00	120.00
Second New York				114.00	114.00
Third New York				388.00	388.00
Twenty-eighth New York			640.00	48.00	688.00
Fourth North Carolina				834.00	834.00
Fifth North Carolina				280.00	280.00
First Ohio	21,772.74	350.00	2,760.00	11,208.00	36,090.74
Tenth Ohio		600.00	2,240.00	9,312.00	12,152.00
Eleventh Ohio	254,787.40	600.00		22,252.00	277,639.40
Eighteenth Ohio	52,179.08		1,440.00	21,792.00	75,411.08

[a] Colorado includes Wyoming.
[b] Connecticut includes Rhode Island.
[c] Kansas includes Indian Territory and Oklahoma.
[d] Louisiana includes Mississippi.
[e] Maryland includes Delaware, District of Columbia, and two counties of Virginia.
[f] Montana includes Idaho and Utah.
[g] Nebraska includes North and South Dakota.
[h] New Hampshire includes Maine and Vermont.
[i] New Mexico includes Nevada.

TABLE V.—*Internal-revenue receipts from oleomargarine, etc.*—Continued.

Internal-revenue districts.	Collections on oleomargarine at 2 cents per pound.	Special taxes of— Manufacturers.	Wholesale dealers.	Retail dealers.	Total.
Fiscal year ended June 30, 1901—Con.					
Oregon [a]			$60.00	$270.00	$330.00
First Pennsylvania			2,800.00	1,958.00	4,758.00
Ninth Pennsylvania				126.00	126.00
Twelfth Pennsylvania				604.00	604.00
Twenty-third Pennsylvania	$42,846.60	$600.00	2,880.00	14,324.00	60,650.60
South Carolina			1,800.00	2,202.00	4,002.00
Second Tennessee				260.00	260.00
Fifth Tennessee			2,240.00	1,772.00	4,012.00
Third Texas	8,280.00		4,780.00	3,730.00	16,790.00
Fourth Texas			1,680.00	1,060.00	2,740.00
Second Virginia			1,320.00	7,310.00	8,630.00
Sixth Virginia				1,636.00	1,636.00
West Virginia			3,200.00	12,740.00	15,940.00
First Wisconsin				488.00	488.00
Second Wisconsin			960.00	160.00	1,120.00
Total	2,032,926.67	16,225.00	83,704.52	385,245.25	2,518,101.44

Internal-revenue district.	Collections on oleomargarine. Domestic at 2 cents per pound.	Imported at 15 cents per pound.	Special taxes of— Manufacturers.	Wholesale dealers.	Retail dealers.	Total.
Fiscal year ended June 30, 1902.						
Alabama				$1,760.00	$2,532.00	$4,292.00
Arkansas				260.00	1,844.00	2,104.00
Colorado [b]	$760.90		$600.00	2,840.00	5,561.00	9,761.90
Connecticut [c]	219,944.80		1,550.00	880.00	9,170.00	231,544.80
Florida				2,020.00	3,722.00	5,742.00
Georgia				2,840.00	4,078.00	6,918.00
Hawaii				960.00		960.00
First Illinois	983,407.82		3,800.00	4,840.00	86,515.23	1,078,563.05
Fifth Illinois				1,780.00	5,244.00	7,024.00
Eighth Illinois					5,108.00	5,108.00
Thirteenth Illinois	3,775.72		450.00	1,320.00	4,274.00	9,819.72
Sixth Indiana	223,849.92		3,000.00	2,760.00	16,566.00	246,175.92
Seventh Indiana					4,730.00	4,730.00
Third Iowa			600.00		36.00	636.00
Kansas [d]	395,873.32		1,800.00	880.00	10,532.00	409,085.32
Second Kentucky					704.00	704.00
Fifth Kentucky	6,235.06		1,200.00	960.00	8,054.00	16,449.06
Sixth Kentucky					2,742.00	2,742.00
Seventh Kentucky					866.00	866.00
Eighth Kentucky					120.00	120.00
Louisiana [e]				1,200.00	7,378.00	8,578.00

[a] Oregon includes Alaska and Washington.
[b] Colorado includes Wyoming.
[c] Connecticut includes Rhode Island.
[d] Kansas includes Indian Territory and Oklahoma.
[e] Louisiana includes Mississippi.

TABLE V.—*Internal-revenue receipts from oleomargarine, etc.*—Continued.

Internal-revenue districts.	Collections on oleomargarine.		Special taxes of—			Total.
	Domestic at 2 cents per pound.	Imported at 15 cents per pound.	Manufacturers.	Wholesale dealers.	Retail dealers.	
Fiscal year ended June 30, 1902—Continued.						
Maryland [a]	$122,520.88	$910.76	$1,600.00	$5,120.00	$6,010.00	$136,161.64
Massachusetts				1,600.00	2,965.00	4,565.00
First Michigan				1,200.00	6,298.00	7,498.00
Fourth Michigan				1,740.00	4,164.00	5,904.00
Minnesota					116.00	116.00
First Missouri	1,534.20		150.00	2,680.00	15,110.00	19,474.20
Sixth Missouri				1,160.00	3,562.00	4,722.00
Montana [b]				720.00	200.00	920.00
Nebraska [c]				2,320.00	1,750.00	4,070.00
New Hampshire [d]				625.00	384.00	1,009.00
First New Jersey				1,600.00	3,400.00	5,000.00
Fifth New Jersey	18,237.42		850.00	3,080.00	21,770.00	43,937.42
New Mexico [e]				480.00	340.00	820.00
First New York					506.00	506.00
Second New York		3.75			48.00	51.75
Third New York					252.00	252.00
Fourteenth New York					90.00	90.00
Fourth North Carolina				480.00	1,766.00	2,246.00
Fifth North Carolina					434.00	434.00
North and South Dakota					388.00	388.00
First Ohio	83,751.90	168.00	1,200.00	2,160.00	13,276.00	100,555.90
Tenth Ohio	173.74			3,080.00	10,228.00	13,481.74
Eleventh Ohio	292,942.12		600.00	360.00	27,082.00	320,984.12
Eighteenth Ohio	47,992.20		600.00	2,320.00	25,956.00	76,868.20
Oregon [f]	60.00			600.00	240.00	900.00
First Pennsylvania				480.00	1,092.00	1,572.00
Ninth Pennsylvania					52.00	52.00
Twelfth Pennsylvania				1,440.00	554.00	1,994.00
Twenty-third Pennsylvania	50,454.72		600.00	4,680.00	12,608.00	68,342.72
South Carolina				720.00	2,696.00	3,416.00
Second Tennessee					766.00	766.00
Fifth Tennessee				480.00	3,094.00	3,574.00
Third Texas	11,018.00		900.00	5,400.00	3,706.00	21,024.00
Fourth Texas				2,040.00	1,304.00	3,344.00
Second Virginia				3,340.00	7,184.00	10,524.00
Sixth Virginia					2,207.00	2,207.00
West Virginia				5,360.00	15,664.00	21,024.00
First Wisconsin				320.00	528.00	848.00
Second Wisconsin				2,760.00	166.00	2,926.00
Total	2,462,532.72	1,082.51	19,500.00	[g] 83,645.00	[h] 377,732.23	2,944,492.46

[a] Maryland includes Delaware, District of Columbia, and two counties of Virginia.
[b] Montana includes Idaho and Utah.
[c] Nebraska includes North and South Dakota.
[d] New Hampshire includes Maine and Vermont.
[e] New Mexico includes Nevada.
[f] Oregon includes Alaska and Washington.
[g] Includes $3,880, advance collections under act of May 9, 1902.
[h] Includes $9,888, advance collections under act of May 9, 1902.

TABLE VI.—*Exports of oleomargarine, by customs districts, 1900 to 1902.*

Customs districts.	Fiscal year ended June 30—		
	1900.	1901.	1902.
	Pounds.	*Pounds.*	*Pounds.*
Baltimore, Md	475,911	1,299,387	661,941
New Bedford, Mass		1,396	
Boston and Charlestown, Mass	158,885	1,820	1,927
Charleston, S. C	1,000		
New York, N. Y	3,164,692	3,433,986	3,537,419
Philadelphia, Pa	64,671	39,800	1,220,819
Bangor, Me			65,445
Providence, R. I			10,000
St. John, Fla		800	
Key West, Fla	240	11,031	6,640
Mobile, Ala	12,101	30,257	26,594
New Orleans, La	17,849	36,162	47,717
Arizona			5,505
Paso del Norte, Tex			24,274
Saluria, Tex	8,564	3,982	9,872
Puget Sound, Wash	61,770	14,350	19,150
San Diego, Cal	32,629	22,545	14,500
San Francisco, Cal	68,980	66,373	17,200
Detroit, Mich	184,370	26,320	52,251
Huron, Mich	1,339	2,000	
North and South Dakota		490	
Total	4,256,067	4,990,699	5,721,254

TABLE VII.—*Monthly exports of oleomargarine, quantities and values, 1900 to 1902.*

Month.	Fiscal year ended June 30—					
	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
July	380,809	36,526	274,188	27,589	401,622	39,819
August	426,589	40,769	437,979	40,328	344,657	33,733
September	323,314	30,673	315,322	31,795	391,818	37,638
October	447,857	40,871	269,054	27,916	349,418	35,607
November	445,717	39,974	327,898	33,528	339,318	35,579
December	249,846	27,232	417,521	43,664	318,338	34,432
January	298,341	27,722	392,143	35,930	956,907	102,199
February	242,895	26,751	661,174	60,611	587,951	59,552
March	411,811	42,757	363,213	35,190	796,496	87,191
April	232,214	22,893	607,087	56,311	481,194	54,432
May	332,441	32,267	546,362	51,654	487,410	50,086
June	464,233	48,109	379,511	39,966	266,125	28,253
Total	4,256,067	416,544	[a] 4,990,699	[a] 484,501	5,721,254	601,521

[a] The totals reported at the end of the year do not exactly agree with the sum of the monthly figures shown above, but the latter are given as published in monthly reports.

TABLE VIII.—*Exports of oleomargarine, quantities and values, by countries, 1900 to 1902.*

Country.	Quantities.			Values.		
	1900.	1901.	1902.	1900.	1901.	1902.
	Pounds.	*Pounds.*	*Pounds.*	*Dollars.*	*Dollars.*	*Dollars.*
Azores, and Madeira Islands		3,326			479	
Belgium	58,265	77,770	106,365	6,073	7,892	10,642
Germany	448,769	1,234,942	997,655	37,049	97,522	108,364
Italy			69,844			6,615
Portugal	2,000	3,850	6,040	200	414	670
Spain		1,500			150	
Sweden and Norway	17,990	16,710		1,400	1,499	
United Kingdom	364,712	148,505	131,292	34,074	14,710	14,433
Bermuda	32,015	39,965	66,859	3,786	5,038	8,267
British Honduras	7,880	19,185	36,663	1,097	2,108	3,535
Dominion of Canada			26,203			2,699
Nova Scotia, New Brunswick, etc		2,000			260	
Quebec, Ontario, etc	3,066	26,410		245	2,650	
British Columbia		400			36	
Newfoundland and Labrador	107,473		153,646	7,200		15,536
Central American States:						
Costa Rica	73,531	119,217	85,680	7,461	11,519	8,195
Honduras	260		1,900	31		215
Nicaragua	3,035	2,200	1,672	397	257	182
Mexico	9,194	4,057	46,790	993	548	7,401
Miquelon, Langley, etc	2,800	1,820	1,700	310	195	192
West Indies:						
British	1,466,638	1,333,358	1,353,324	146,959	134,498	137,332
Danish	116,890	115,090	113,975	8,530	9,523	11,296
Dutch	41,605	49,234	44,283	3,280	4,084	3,926
French	157,200	140,300	129,614	13,501	14,152	12,735
Haiti	50,088	168,898	216,280	4,989	17,972	23,756
Santo Domingo	9,784	6,400	2,610	906	580	247
Cuba	516,463	722,075	777,534	60,693	81,909	88,467
Porto Rico	219,140			22,776		
Brazil	100			18		
Colombia	113,777	122,424	89,065	9,675	11,125	8,076
Ecuador	837	1,740	13,182	106	238	1,447
Guianas:						
British	133,236	182,800	245,622	14,638	20,778	26,831
Dutch	59,700	58,536	39,000	5,486	5,032	3,382
Peru		120			12	
Uruguay			500			50
Venezuela			300			27
Russia, Asiatic		14,350			1,494	
China	7,626	28,841	9,850	670	3,043	1,555
East Indies: British	2,300	5,500	a1,510	328	605	a211
Hongkong	1,560		2,650	194		265
Japan	41,309	62,377	35,850	4,412	5,820	3,129
Hawaiian Islands	118,396			11,800		
British Africa	66,908			7,102		
British South Africa		237,738	106,762		23,683	10,618
British East Africa		29,110	46,490		3,840	5,658
Canary Islands		336			32	

a British and Dutch.

TABLE VIII.—*Exports of oleomargarine, quantities and values, etc.*—Continued.

Country.	Quantities.			Values.		
	1900.	1901.	1902.	1900.	1901.	1902.
	Pounds.	*Pounds.*	*Pounds.*	*Dollars.*	*Dollars.*	*Dollars.*
Portuguese Africa		1,070	11,000		105	1,077
All other Africa	50			8		
Other countries	1,470	8,545	[a] 749,544	157	699	[b] 74,510
Total	4,256,067	4,990,699	5,721,254	416,544	484,501	601,521
Average per pound......cents				9.8	9.7	10.1

[a] Netherlands, 743,275. [b] Netherlands, 73,800.

TABLE IX.—*Exports of oleo oil, by customs districts, 1900 to 1902.*

Customs districts.	1900.	1901.	1902.
	Pounds.	*Pounds.*	*Pounds.*
Baltimore, Md	43,227,556	34,237,714	16,563,147
Bangor, Me	354,243	77,098	175,652
Boston and Charlestown, Mass	5,897,560	7,368,709	6,545,756
New York, N. Y	87,167,125	111,553,553	104,216,663
Norfolk and Portsmouth, Va	348,997		33,800
Newport News, Va		81,819	393,630
Philadelphia, Pa	9,550,617	6,482,325	9,249,487
Portland and Falmouth, Me	80,840	132,151	318,746
New Orleans, La		300	1,110
Paso del Norte, Tex			14,203
Saluria, Tex		19,494	8,832
Detroit, Mich	81,900	870,853	890,567
Huron, Mich	24,000	816,397	134,495
North and South Dakota	6,049		
Vermont	794	11,000	
Total	146,739,681	161,651,413	138,546,088

TABLE X.—*Monthly exports of oleo oil, quantities and values, 1900 to 1902.*

Month.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
July	12,692,477	872,205	13,342,792	985,403	13,212,631	1,057,956
August	13,438,025	910,130	17,076,266	1,256,983	15,759,022	1,296,364
September	9,681,527	700,127	11,649,497	842,042	14,360,066	1,255,737
October	8,609,274	656,009	12,703,835	931,844	14,028,348	1,221,486
November	9,167,054	672,767	13,264,917	960,790	10,098,115	897,527
December	11,593,796	857,502	10,703,607	768,479	13,462,994	1,121,843
January	9,875,713	782,610	13,262,121	907,244	10,367,719	968,024
February	12,583,941	923,138	8,714,704	632,681	8,765,687	800,367
March	13,495,147	961,799	12,481,946	912,137	8,173,969	727,564
April	11,102,549	778,246	13,360,520	1,029,620	12,703,533	1,200,033
May	13,271,051	926,925	17,594,957	1,326,027	9,304,298	907,368
June	21,229,127	1,462,398	17,496,251	1,293,123	8,309,706	800,700
Total	146,739,681	10,503,856	161,651,413	11,846,373	138,546,088	12,254,969

TABLE XI.—*Exports of oleo oil, quantities and values, by countries, 1900 to 1902.*

Countries.	Quantities.			Values.		
	1900.	1901.	1902.	1900.	1901.	1902.
	Pounds.	*Pounds.*	*Pounds.*	*Dollars.*	*Dollars.*	*Dollars.*
Austria-Hungary	73,634	676,625	339,546	4,786	42,350	26,540
Belgium	2,892,778	1,800,757	1,703,377	212,457	135,558	151,273
Denmark	8,628,948	11,734,927	12,933,733	675,053	909,984	1,203,164
France	167,047	22,500	1,020,000	10,800	1,800	87,350
Germany	26,780,986	33,482,368	27,323,930	2,104,818	2,549,853	2,489,217
Italy	250	617,947	2,243,550	15	42,721	210,687
Netherlands	85,976,848	85,442,112	68,884,209	5,912,334	6,131,071	6,042,590
Turkey, European		44,788	912,658		2,875	70,796
Sweden and Norway	13,500,332	17,059,746	13,614,461	960,047	1,224,334	1,073,412
United Kingdom	7,265,764	9,557,733	8,024,899	512,745	717,056	755,525
Dominion of Canada:						
Nova Scotia, New Brunswick, etc		46,766	700		3,506	70
Quebec, Ontario, etc	27,494	19,130	816,675	1,906	1,321	74,056
Newfoundland and Labrador	709,817	1,043,005	647,106	54,353	75,928	62,454
Mexico		19,494	25,735		1,485	2,496
West Indies			29,269			2,965
Haiti		5,600			448	
Cuba		8,255			494	
Brazil	4,652			391		
Guiana, British	3,000			270		
British West Africa		68,580			5,487	
British Australasia	607,625			45,572		
Other countries	100,506	1,080	26,240	8,309	102	2,374
Total	146,739,681	161,651,413	138,546,088	10,503,856	11,846,373	12,254,969
Average per pound..cents				7.2	7.3	8.8

TABLE XII.—*Production and distribution of filled cheese and total revenue receipts therefrom, 1897 to 1902.*[a]

Fiscal year ended June 30—	Quantity produced.	Quantity withdrawn tax paid.		Received, all sources.
		For domestic use.	For export.	
	Pounds.	*Pounds.*	*Pounds.*	*Dollars.*
1897 (from September 4, 1896)	1,663,067	1,475,954	187,113	18,992.38
1898	1,402,861	1,383,993	18,868	16,518.55
1899	1,688,650		1,688,650	18,098.42
1900	1,574,979	48,492	1,526,487	17,064.48
1901	1,305,459	52,191	1,253,268	14,652.64
Total	7,635,016	2,960,630	4,674,386	85,326.47

[a] Year ended June 30, 1902, none.

TABLE XIII.—*Monthly production and distribution of filled cheese, 1900 to 1902.*[a]

Year and month.	Quantity produced.	Quantity withdrawn, tax paid. For domestic use.	Quantity withdrawn, tax paid. For export.
1899.	*Pounds.*	*Pounds.*	*Pounds.*
July			
August			
September			
October	84,375		84,375
November	113,346		113,346
December	168,742	26,019	142,723
1900.			
January	218,508	3,613	214,895
February	221,673		221,673
March	235,818	3,638	232,180
April	319,846		319,846
May	212,671	15,222	197,449
June			
July			
August			
September	20,913		20,913
October	95,133		95,133
November	229,269		229,269
December	175,663		175,663
1901.			
January	257,509	3,967	253,542
February	250,549	4,163	246,386
March	126,069	3,423	122,646
April	112,906	3,190	109,716
May	37,448	37,448	
June			
Total	2,880,438	100,683	2,779,755
Total since September, 1896	7,635,016	2,960,630	4,674,386

[a] Year ended June, 1902, none.

TABLE XIV.—*Number of manufacturers, wholesalers, and retailers of filled cheese, by States, 1900 to 1902.*[a]

State or Territory.	For year ended June 30— 1900. Manufacturers.	1900. Wholesalers.	1900. Retailers.	1901. Manufacturers.	1901. Wholesalers.	1901. Retailers.
Illinois	6			5		
Louisiana						1
Maryland			2			2
Total	6		2	5		3
Number of States and Territories in which located	1		1	1		2

[a] None in 1902.

TABLE XV.—*Internal-revenue receipts from filled cheese, by districts, 1900 to 1902.*[a]

Internal-revenue districts.	Collections on filled cheese at 1 cent per pound.	Special taxes of—			Total.
		Manufacturers.	Wholesale dealers.	Retail dealers.	
Year ended June 30, 1900.					
First Illinois	$15,750.47	$1,300.01		$14.00	$17,050.48
Maryland [b]					14.00
Total	15,750.47	1,300.01		14.00	17,064.48
Year ended June 30, 1901.					
First Illinois	13,055.97	1,566.67			14,622.64
Louisiana				6.00	6.00
Maryland [b]				24.00	24.00
Total	13,055.97	1,566.67		30.00	14,652.64

[a] Year ended June 30, 1902, none.
[b] Including the State of Delaware, District of Columbia, and two counties of Virginia.

View of Athenia, N. J., Site of Animal Quarantine Station.

SUPERINTENDENT'S RESIDENCE AT ANIMAL QUARANTINE STATION, ATHENIA, N. J.

AN. RPT. B. A. I. 1902.

ONE OF THE BARNS AT ANIMAL QUARANTINE STATION, ATHENIA, N. J.

Interior of Barn at Animal Quarantine Station, Athenia, N. J.

THE QUARANTINE STATION AT ATHENIA.

The Bureau of Animal Industry is rejoicing in the new quarantine station at Athenia, N. J., and the illustrations shown here tell the story of beauty and utility. The old station, located at Garfield Station, was in many ways undesirable in respect of all the requirements of a quarantine station. At Athenia the Government owns the property, which was not the case at the old location. The work on the new station was begun on April 1, 1901.

The Breeder's Gazette of June 4, 1902, contained an excellent description of the station at Athenia, from which liberal extracts are taken, as follows:

For a suitable animal quarantine station several features are important. Such a station should be readily accessible and so situated that animals can be directly transferred to it from the ocean steamship either by water or rail. It is important that there be good railroad facilities for shipping animals to their destination at the expiration of the period of detention. A healthful location, with land elevated and well drained, is desirable, and while somewhat isolated not to such an extent as to cause importers inconvenience in securing forage for stock and board for attendants. In fact, an ideal quarantine station should be so situated as to receive imported animals with the least possible delay, expense, and inconvenience to the owner, and at the same time safeguard our native animals from any possible infection; so situated and equipped as to be favorable to the well-being of the new arrivals during their detention, and also offering owners the best of transportation facilities at the expiration of the quarantine period. In some respects a water front would be an ideal location, but suitable and purchasable land accessible to such a port as that of New York is not readily secured. In May, 1900, Congress made an appropriation which enabled the United States Department of Agriculture to take active steps in securing land for a new station, which, of course, signified an early abandonment of the old station and a return of the property to the lessors. About this time representatives of the Department made a thorough and faithful search for a water-front location which would fulfill essential requirements as above given, and after a fruitless effort the idea was abandoned. * * *

One important and practical feature in planning the new station was the location of roads and buildings, and in this matter due regard was given to the purposes for which such a station exists—the guarding of our live-stock interests from the dangers incidental to the introduction of contagious or infectious diseases. From the accompanying plan it will be observed that the buildings are isolated; that a 32-foot road separates the various yards; that extending from the siding at the railroad is a broad street for receiving and distributing animals to the various buildings. Surrounding the entire plot is a street terminating at each end of the loading platform. This street is for the exit of animals. Thus it will be readily seen that complete isolation of the various importations and avoidance

of passing released animals over ground recently covered by new arrivals is easily accomplished.

But the plotting of the ground is not the first feature observed by a visitor. Standing at the entrance to the grounds and in the center of a 5-acre reserve is the recently completed residence for the superintendent. With a side entrance to the office, the building combines utility with substantial grace, and when the landscape artist has completed his work there will be an added beauty to this homelike structure. For entrance to the quarantine grounds and buildings a special written permit must be secured at the office, for the station is not an exhibition ground, and a lack of restrictions would be contrary to the purposes for which it was established. * * *

The substantial character of the stables can not fail to impress one upon entering the grounds. Ranging in capacity from 11 head up to 80, the general plan for all is the same. Increased capacity is secured by increasing the length of the building, all other proportions remaining constant. Constructed of brick, with bluestone trimmings, these stables present a permanent and serviceable appearance, and with front and rear entrances sufficently wide to admit of the passing of a team of horses there can be no opportunity for cattle to become bruised in entering or leaving their quarters. The exterior of the buildings is but suggestive of the substantial structure of the interior, and, after all, this is the portion of the greatest interest to importers.

The floors, walls, and fittings remind one of the pus ward of one of our modern hospitals, as the absence of woodwork and the hard, smooth surfaces offer no crevices for the lodgment of bacteria and render the problem of disinfection comparatively simple. The woodwork of the interior of the buildings is confined chiefly to the roof, which is ceiled with yellow-pine matched lumber. The feed boxes are of oak and easily removed for cleaning and disinfecting.

Floors and walls are of cement. Gutters are covered with an iron grating, and the fittings of tubular iron are firmly embedded in the cement floors. A passageway of 3 feet in front of the cattle is a convenience to the attendant when feeding. Buildings with a capacity of 11 head have 1 large box stall and 10 single stalls. In larger buildings the number of box stalls is increased proportionately. Ample provision is made for storing hay and grain, and with running water inside each building there is no necessity of turning animals out in inclement weather.

A vital feature in the construction of a stable is the drainage. This problem is solved by the construction of cesspools for each stable, and into this the contents of gutters are drained. It is intended that a hose be attached to the hydrant and the drains thoroughly flushed each day, and upon the attendant's faithfulness in this matter depends the sanitary condition of drain and stable.

An ample supply of pure water is essential for such a place as we are describing, and in this respect the Athenia quarantine station is particularly fortunate. Standing upon an elevation near the center of the ground is the 11,000-gallon tank, which is 55 feet above the front entrance. Below the tank is the pump house, containing the pump and 5-horsepower gasoline engine. Beneath is the 6-inch well, sunk to a depth of 168 feet and exhibiting a rise of water to within 68 feet of the surface. Three-inch, 2-inch, and 1-inch pipes are laid throughout the grounds, and inside and outside of each building is located a hydrant, which, at the attendant's will, furnishes for the cattle a supply of water unsurpassed in quality.

For loading and unloading stock with the least possible risk arrangements at the new station are the best. Imported animals are not allowed to pass over any highway until released from quarantine. In order to accomplish this the railroad siding is extended to the border of the station property, and the stock is loaded directly upon the quarantine grounds.

Excepting at some of the large stock yards in our country, the loading and unloading facilities are such that cattle must pass up or down a steep incline. This objectionable feature does not exist at the new station, for the track is depressed, permitting animals to land at once from the car upon terra firma, thus reducing to the minimum the dangers incidental to shipment.

There are at present at the Athenia station 15 buildings, with an aggregate capacity of 425 cattle. Each importation is assigned a separate yard, and stable attendants upon one importation are forbidden to enter buildings or inclosures where animals of other importations are held, as this is a quarantine station and isolation is essential.

The expense for transportation and feed must be met by the importer, and it devolves upon him to furnish an attendant. The superintendent of the station, a veterinarian, carefully inspects the animals immediately upon arrival of the ship in port, and during the quarantine period observes them for evidences of contagious or infectious diseases, and, when it is required, furnishes medical attendance. Other regular employees assist the superintendent in his duties, care for the roads and fences, repair and disinfect buildings, and assist in loading and unloading live stock.

The quarantine period for cattle is ninety days from the date of sailing of ship, which, allowing ten days for the trans-Atlantic passage, means about eighty days at the station. For swine, sheep, and other ruminating animals, such as goats, deer, and camels, the period of detention is fifteen days' actual time at the station.

There has been expended thus far at Athenia $61,000 in round numbers; and of this amount $31,000 was for land and residence, and the balance for stables, water system, fencing, and miscellaneous items. Only one year has passed since active work has begun. * * *

The following description is from the Country Gentleman of December 18, 1902:

While the most desirable and ideal site for a quarantine station is beyond doubt a water front, the United States representatives who had the matter of selection in hand found it impossible to secure such a place. After inspecting the country along the Jersey coast as close as possible to the port of New York they settled on Athenia, a quiet hamlet nestled in the foothills of the Orange Mountains, 12 miles from New York—forty minutes from the metropolis— * * * and as picturesque a spot as one might wish to look on. As one approaches the station he is impressed by its tidy and artistic appearance—more like the private grounds of a wealthy gentleman's country estate than a Government animal quarantine station. * * * It takes considerable time and thought to convert such a place into an ideal quarantine station, and Dr. Pope [superintendent] is to be congratulated on his progress in so short a time. Particular attention has been given to the laying out of roads and the construction of barns and every precaution taken to guard the live-stock interests from the dangers incidental to the introduction of contagious or infectious diseases. Released animals do not pass over the same road as incoming ones. All barn buildings are isolated, and a 32-foot road separates the various yards.

At the entrance to the grounds is the superintendent's home, standing imposingly in the center of a 5-acre reserve, which the landscape gardener has commenced to beautify. A permit must be obtained to be admitted to the grounds and certain specified buildings, but one importer is not supposed to visit the importation of another breeder. Dr. Pope insists that every precaution against the spread of disease must be taken, and for this stand he is to be commended.

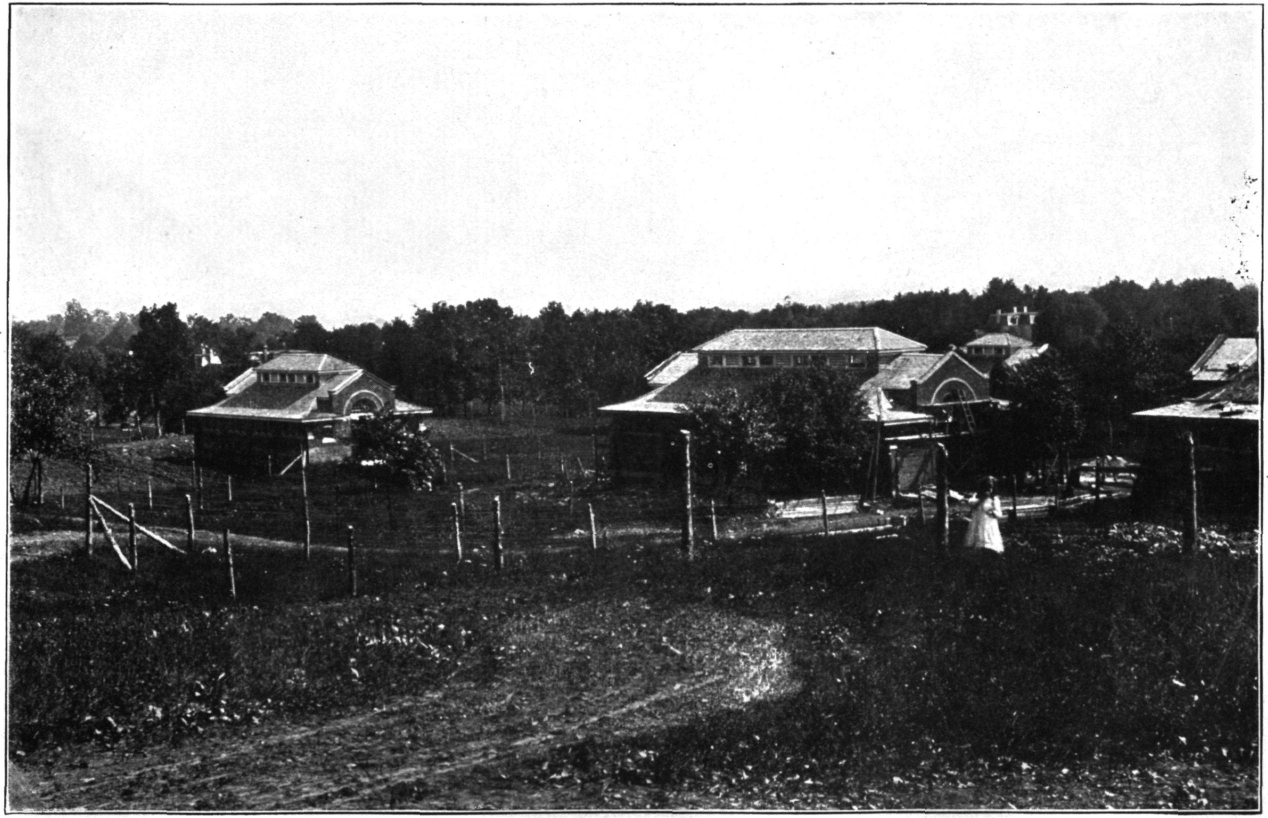
The stables at Athenia are wonders of cleanliness, and, as may be seen from the illustration, substantially built. They vary in size to accommodate anywhere

from 11 to 80 animals, are built of brick with blue-stone trimmings; floors and walls of cement; roof ceiled with yellow-pine matched lumber; feed boxes of oak, and easily removed for cleaning and disinfecting; gutters behind cows covered with an iron grating, and these may be flushed out at any time. The passageway through the center of the barn is sufficiently wide to admit the passage of a team of horses from front to rear entrances. In front of each row of cows is a 3-foot passageway for the convenience of the attendant when feeding. In barns holding 11 head there are 1 large box stall and 10 single stalls, and the number of both increases proportionately with the capacity of the building. Hay and grain can also be conveniently stored within; and, as running water is also inside, animals need not be turned out in inclement weather to drink.

The ventilation of these stables is all that could be desired. The doors at either end are made in two sections, so that the top half may be thrown open to admit air and the lower half remain closed to keep animals from departing. The cows stand back to back in rows on each side of the passageway, and in front of each animal is a window which, when open, inclines toward the ceiling, preventing any direct draft on the animal. In the top of the roof are also a number of windows which may be opened automatically from the barn floor when desired. There is plenty of light and air, and with so many windows the sun can not help finding its way into all parts of the stable.

One of the most important features about the stables is the drainage. The contents of the gutters are drained into cesspools. On the outside and inside of each stable is a small hydrant, and by attaching a hose to either the drains may be thoroughly flushed each day.

The railroad tracks extend to the quarantine grounds, and are depressed, so that cars are on a level with the loading and unloading platforms, making their operation both convenient and safe. In the 15 stables now at the Athenia quarantine station, 425 animals can be comfortably cared for. The yards surrounding each stable are comparatively level and spacious. * * *



Rear View of Animal Quarantine Station, Athenia, N. J.

Plate XXXVII.

View of Old Animal Quarantine Station, Garfield Station, N. J.

REPORT ON AN ENZOOTIC AMONG CATTLE CAUSED BY A BACILLUS OF THE ENTERITIDIS GROUP.

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AND

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INTRODUCTORY NOTES.

In accordance with verbal instructions from the Chief of the Bureau of Animal Industry, one of the writers hereof was directed to enter into consultation with a local veterinarian for the purpose of investigating a peculiar and highly infectious disease which had appeared among the cows on a dairy farm in the vicinity of Washington, D. C.

The cause of this outbreak was at first suspected of being due to a change of diet, resulting in intestinal disturbances with symptoms indicative of toxic poisoning. However, the postmortems on the animals did not show sufficient lesions to account for the excessive symptoms exhibited, and a diagnosis was therefore withheld.

Owing to the proximity of the outbreak to the laboratory of the Bureau, and in view of the fact that occasional reports are received at this office from various parts of the country describing unrecognized affections of what may probably be the same disease, it was considered an excellent opportunity for making a thorough investigation of the disease in question.

Various culture media were inoculated in these cases from the brain, spleen, liver, and heart, and pure cultures of a motile microorganism were obtained in the majority of tubes, although obvious contaminations were encountered in several instances, while some of the tubes remained sterile. The bacillus hereafter described was isolated from every animal (seven in number) that succumbed to the disease while under our observation; and, after a preliminary examination of the cultures, it was thought that this organism bore a striking similarity to the para-colon bacilli. Further bacteriological study confirmed this opinion, and it appears from the evidence hereafter to be produced that a highly virulent bacillus belonging to the enteritidis group was the causative factor in this outbreak.

HISTORY.

On visiting the premises where the disease occurred it was found that the affected herd was stabled on the second floor of a large hillside barn. The stable was adequately ventilated and well lighted. The stalls and runways were ample and unobstructed and the place kept in excellent order. In fact, the surroundings on this floor were in an apparently sanitary condition, and the only objection that could be found with the management of the premises was in the disposition of the droppings. These were thrown into the basement under the stable floor where they were allowed to accumulate to an unwarranted degree. To all appearances this state of affairs had continued for a long period, and existed as a possible menace to the health of the cows stabled on the floor above.

The herd had been on pasture during the day until within two weeks of the outbreak, at which time (November, 1901) they were placed in the barn and stable-fed. The stable was provided with two rows of box stalls which lined the opposite sides. Running parallel with these through the center of the barn was a wide passageway separating two lines of single stalls. During the winter season the cattle from each half of the stable were allowed the use of small exercising lots on the corresponding sides of the barn, which were provided with large watering troughs. It was a noticeable and striking circumstance that the cattle on the north side of the barn only became affected. The herd contained 21 cows, 12 of which were stabled on the north side, and the remainder in the southern half of the barn. Of these 12 animals 8 contracted the disease and died, 1 of which succumbed only after running a chronic course. Three others showed the prodromal symptoms hereafter to be described, but eventually recovered, and at present writing are enjoying apparent good health. These cows were all grade dairy animals and in milk. Before the present outbreak they were, without exception, in good vigorous health.

The cattle on the farm had been purchased from five to eight months previously of neighboring farmers, but no similar disease had been known to occur on any of the premises whence these cattle had been obtained.

Why the cattle in but one-half of the barn should become affected was not possible of elucidation, but the important point remains that when the affected cattle were removed from the stable, their stalls and mangers disinfected, and their bedding burned, that these prophylactic measures served to be instrumental in checking the disease and in restricting it to one line of cows. It is important to mention also that the owner had a larger number of cows which were kept on the same farm but in a different stable. They were furnished with similar food and supplied with water conducted from the same source as that used by the affected animals, each stable of cows having its individual troughs. These cattle remained well.

SYMPTOMS.

The disease[a] appeared suddenly, the first knowledge of its presence being communicated by the stableman, who reported that one of the cows was suffering from a "fit." On close questioning it was learned that the animal had refused its food on the two preceding days and had appeared languid, standing with back arched, muzzle protruding, breathing accelerated, and with an anxious expression as if suffering from pain. This cow died on the day following the convulsion.

At the time of our first visit three other cows were observed to be affected with the disease in varying degrees, the first observable symptom being a refusal to eat and drink, with suspension of rumination and diminution in lactation. Excessive salivation was apparent in most cases, and a clear, ropy saliva kept dribbling continuously from the mouth. Grinding of the teeth was occasionally observed. The ears were drooping and the eyes staring and void of expression. The pupils were dilated and the conjunctiva was congested and of a yellowish red tinge. In cows Nos. 5 and 7 a purulent lachrymal discharge developed, associated with an impairment of vision. At times the animals would prop themselves in the stalls with their heads pressing against the manger. Occasionally convulsive paroxysms were observed, from the effects of which they would recover in a few minutes. For instance, an animal was observed trying to eat a bran mash when, suddenly, a clonic contraction of the muscles occurred. The cow arched its back, the muzzle was greatly elevated, and the eyes rolled back in their orbits so that only the sclerotic coat was visible as a result of this spasm. The animal, with muscles trembling and twitching, moved backward and, losing power of coordination, fell heavily to the floor. The head was thrown back and forth, attempts at locomotion made, and at times a lowing sound produced as if in pain. Muscular twitching continued, the eyes remained rotated toward the canthus, and reflexes were abolished. The cow, after remaining several minutes in this condition, recovered coordination, and, struggling to its feet, stood with back arched, muscles of shoulders occasionally trembling, muzzle extended, and the eyes staring and watery. Cryptostasis was observed in some cases, while in others the bowels were very loose and the droppings dark and frequent. Respirations were somewhat accelerated and laborious, in some instances the breathing being heard some distance away. The pulse was rapid and the heart seemed to lack quality and force. The temperature varied from 102.7° to 104.1°. On auscultation the lungs appeared normal, but the intestines showed an absence of peristaltic sounds in most cases. The visible mucous membranes were congested

[a] We are indebted to Dr. J. P. Turner, V. M. D., of Washington, D. C., for his kindness in having brought this outbreak to our notice, and for information regarding the earlier symptoms of the disease.

and of a yellowish color. The wild look from the eyes of the affected cows was at times accentuated by the extreme excitability present, at which time they seemed ill at ease. The gait was irregular, and in cow No. 5 partial paralysis of the forelegs was apparent. The attacks of spasms became more frequent, between which the animal would remain in the recumbent position most of the time without appearing very sick. These symptoms became aggravated, convulsions occurring from three to seven times a day until finally death took place.

Course.—The duration of the disease after the first noticeable symptom varied but slightly in the acute cases. One animal died in forty-eight hours, 4 succumbed on the third day, and 2 on the fifth day. Cow No. 8 first showed illness on November 10 and developed somewhat similar symptoms to those described above, but of a milder type. After the sixth day the evacuations of the bowels, which had been semifluid, became more natural, the appetite gradually returned, and the animal apparently recovered. Nothing further was heard of this case until December 6, when we were informed that the cow had died suddenly in a convulsion, after showing but slight indisposition and capricious appetite during that week. The owner also stated that during the interval between the apparent recovery and the reacerbation of the symptoms, convalescence did not progress satisfactorily. From the postmortem notes (see p. 301) it will be seen that the animal had not made a complete recovery after the first attack, as was supposed, but that the disease had run a chronic course, as indicated by the lesions presented.

PATHOLOGICAL ALTERATIONS.

In describing the postmortem lesions, it would seem advisable to discuss the alterations of the seven acute cases collectively since they varied but slightly from each other, although they differ greatly from the postmortem shown by the last cow, which died after the disease had run a chronic course. Three of the former were killed several hours before their natural death would have occurred, in order to procure fresh and uncontaminated material for bacteriological examination.

The postmortem examination on cows Nos. 2 and 5 revealed absolutely no alterations until the intestines had been opened and the heart incised. In fact, in all the acute cases it was surprising to observe such trivial alterations totally out of proportion to the symptoms manifested. The most noticeable and characteristic lesion to be observed was the presence of petechial hemorrhages under the endocardium in every case. Usually they appeared as extravasations around the columnæ carneæ situated at the insertion of the valves. An excess of pericardial fluid tinged with blood was observed in only two cases. The lungs were, without exception, in excellent condition. The mucosa of the abomasum was slightly injected in cows Nos. 1, 6,

and 7. The small intestines showed hemorrhagic extravasations here and there under their serous membrane. The liver, spleen, and kidneys were apparently normal. In three cases the bile was very thick and viscid and the gall bladder distended and inflamed. The urine appeared normal. On opening the cephalic cavity the meninges in all cases presented a very much injected condition of the blood vessels and inclosed a considerable quantity of a blood-tinged fluid. The veins of the cerebrum and cerebellum were likewise congested and dilated, and an increased quantity of fluid was observed in the fourth ventricle. On section, the brain appeared abnormally moist and edematous. Numerous tubes of various culture media were inoculated from these affected tissues and incubated, both aerobically and anaerobically. Pure cultures of the causative bacillus were invariably obtained in those tubes that became fertile from the heart, spleen, and brain with contamination in cultures made from the liver and the hemorrhages beneath the serous lining of the intestines. A very small proportion of the tubes inoculated from the lung and kidney became fertile. After cover-glass preparations had been made, specimens of the diseased organs were placed in preserving fluid preparatory to sectioning. The films, when properly stained, showed the specific bacillus in small quantities in the various organs, especially the brain and lesions of the heart.

Of great interest are the postmortem alterations shown by the last animal to succumb to the disease. As before mentioned, this cow (No. 8) had shown early symptoms of the affection, but had presumably reacted to treatment and was supposed to be in good health until she was reported dead. It was then learned that her appetite had been capricious for the previous week and her general appearance unthrifty, although not sufficient to cause alarm. Death occurred 26 days after the first symptom was observed.

Autopsy.—The subcutaneous, muscular, and adipose tissues appeared normal. The lungs showed on their surface and in their substance small hemorrhagic extravasations, but no large areas of inflammation. A few petechiæ were apparent on the costal pleura, and numerous large hemorrhagic patches were observed on the diaphragmatic pleura. Pericardial sac contained a small quantity of a blood-tinged fluid. The pericardium showed petechial hemorrhages both in the parietal and visceral layers. The endocardium contained hemorrhagic extravasations scattered over its surface, especially at the insertion of the chordæ tendinæ of the valves. The liver was attached closely to the diaphragm and showed, besides punctiform hemorrhages, numerous firmly coagulated areas of necrosis scattered throughout its substance; these areas varied from one-eighth to 1¼ inches in diameter. The gall bladder was intensely inflamed on its internal surface and distended with thick ropy and flaky bile. The kidneys were congested and showed one or two foci within their sub-

stance in the early stage of coagulation necrosis. The bladder was empty and normal. The spleen appeared normal in size and consistence, but contained numerous hemorrhagic effusions under its capsule. The mucosa of the abomasum showed two inflamed and ulcerated patches the size of a silver 10-cent piece about the pylorus, while the other portions appeared pale and between the coats of the greatly thickened wall there was an intense inflammatory edema. The pancreas was swollen and surrounded by a gelatinous exudate. This exudate extended between the folds of the mesentery, especially along its attachment to the small intestine. The latter showed inflamed areas both under its mucous and serous coats. The cecum and colon presented numerous petechial hemorrhages scattered over the entire serous wall. The mucosa of this portion of the intestinal tract was not affected. The parietal peritoneum showed only a few isolated ecchymotic spots. The lymphatic glands of the mediastinal, sublumbar, and mesenteric regions were edematous, but not reddened. The brain in this case was apparently normal. Cultures of the specific bacillus were obtained from the liver, kidney, spleen (Pl. XXXIX, fig. 2), heart's blood, and brain.

BACTERIOLOGY.

MORPHOLOGY.

A microscopic examination of cover-glass preparations made from the brain, heart, liver, and other organs reveals the presence of a bacillus with rounded ends measuring from 1.4 to 2.2 microns in length and from 0.5 to 0.6 micron in breadth. The largest bacilli are observed in the fresh tissue and on gelatin media (Pl. XXXVIII, fig. 2), while agar cultures show considerably smaller rods (Pl. XXXIX, fig. 1). The bacilli are frequently arranged in twos joined end to end, and on rare occasions three may be seen. In old bouillon cultures, involution forms are quite common, some showing as coccoid bodies, while others appear longer and more slender than usual and swollen at one or both extremities or in the middle. The bacilli take the stain slowly as a whole, but are readily colored peripherally with all the ordinary aqueous stains. They are decolorized by Gram's and Gram-Weigert's method, but stain nicely after Lœffler's and Ziehl-Nielsen's method. Examined in hanging drop, the bacilli are seen to be actively motile, some organisms starting from an almost quiescent state and progressing across the field in tumultuous haste, while others show active nonceasing rotary movements with constant darting to and fro. Flagella in peritrichic arrangement are readily demonstrated by Lowit's method of staining, and vary in number from 1 to 9, although the majority of flagellate forms show between 3 to 5 flagella, about 4 to 5 times the length of the organism (Pl. XL, fig. 1).

The bacillus is an aerobe, facultative anaerobe, and does not form spores, nor does it show vacuoles, crystals, or capsule. Its patho-

genesis has been retained in bouillon cultures that have been kept in the laboratory for a period of seven months.

CULTURAL CHARACTERISTICS.

Bouillon.—In peptonized beef bouillon (1 per cent + phenolphthalein) there is a well-marked cloudiness in 12 hours, and in 24 to 48 hours a thin, evanescent pellicle forms, which is easily destroyed by shaking the tube. This film is scanty and irregular and does not appear if the tubes are handled during the first day's growth, but a marginal ring is always observed adhering to the tube. After standing two or three days a whitish sediment forms and the media above is clearer than after the first 24 hours. No appreciable difference was observed in the growth when alkaline bouillon (1 per cent — phenolphthalein) was used. In bouillon to which 1 per cent dextrose has been added, the growth is similar but more profuse with the appearance of numerous small bubbles of gas in the media which accumulate at the surface of the liquid.

Gelatin.—On gelatin[a] plates the colonies are not apparent to the naked eye until after 48 hours, and after 72 or more hours they show as hemispherical glistening pearly bodies about 2 mm. in diameter, with a dark central nucleus and well-defined margin. The deep gelatin colonies appear as very small, round, white particles about 0.25 mm. in diameter. In punctures in gelatin tubes the growth appears along the track of the platinum wire in about 48 hours as white-beaded colonies. At the surface the growth may build up like a surface colony on a plate or spread over the whole exposed media, probably depending on the presence of a moist surface upon which to spread. If the gelatin tube is inoculated while the media is fluid and then solidified, a number of gas bubbles form; this also takes place in agar tubes treated in the same way, and presents a broken-up condition of the media with spaces filled with gas. Liquefaction of gelatin does not take place.

Agar.—On plates containing this media the surface colonies appear in 12 hours and increase till from 60 to 72 hours, when they obtain a diameter of about 3 mm. The surface is smooth and mushroom-shaped, the borders being thin and regular. They are pearly or bluish white by direct rays and distinctly brown by transmitted light. The deep colonies are round or lentil shape and white. The colonies at the bottom of the media against the glass are quite transparent, with a white nucleus in the center and the borders ameboid or undulating, attaining at times a diameter of 8 mm. In stab-agar cultures gas is formed, causing the media to present an irregularly broken-up appearance. On slant agar there is nothing characteristic, the growth along the needle track being a confluent, thin, moist, grayish white

[a] Gelatin and agar media, also the bouillon in fermentation tubes, were made in the usual manner, having a titre 1 per cent + to phenolphthalein

layer, quite abundant and not inclined to spread; the borders are uniform and the material fairly viscid in consistency.

Potato.—A lemon-yellow growth takes place on this medium in 48 to 72 hours, after which it becomes distinctly brown. The growth is thin, moist, and much more viscid than on agar.

Milk.—In milk there is no perceptible change for 6 or 7 days, after which the medium becomes opalescent in appearance, and in 10 to 12 days it shows a slight translucency and a light straw color. This clearing of the fluid results from the solution of the casein and not from saponification, as fatty acids are not formed as an emulsion upon the surface after agitating the milk which has been acidulated and boiled. A whitish homogeneous sediment forms at the bottom of the tube about this time, while at the surface several large globules of liberated fat may be seen. Coagulation does not occur; instead the reaction of the media becomes slightly alkaline after an initial acidity. Tubes which have been under observation for 6 weeks were boiled without changing the appearance of the contents. On the addition of a few drops of acetic acid a thick, ropy coagulum was precipitated. In litmus milk the medium becomes decolorized after 24 hours and then assumes a slightly pinkish tinge. After 6 days the blue color gradually returns, and although the medium becomes alkaline the original color does not appear, but assumes a muddy blue aspect. As in normal milk, this medium becomes translucent, with the formation of a yellowish white precipitate at the bottom of the tube.

Blood serum.—On dog serum the growth is not so profuse, forming an irregular, narrow, thin, grayish white film, but in the condensation water the bacilli grow vigorously.

Fermentation of sugars.—In fermentation tubes containing 1 per cent dextrose bouillon there is a lively production of gas, filling about one-third of the closed branch of the tube, 6 c. c. within 24 hours, 2 c. c. additional on the second day, and ceases on the third day, when about 9 c. c. of gas has been generated. The bouillon becomes clouded in the open bulb, extending through the arm into the closed portion, and a medium amount of a brownish, flaky precipitate collects in the arm of the tube. Three-eighths of the gas is absorbed when treated with caustic potash, and when the remaining gas is brought in contact with the flame there is a feeble explosion (hydrogen), which makes the gas ratio read $\frac{H}{CO_2} = \frac{5}{3}$. The reaction of the bouillon in both the bulb and the closed arm of the tube becomes strongly acid. In fermentation tubes containing 1 per cent lactose and saccharose bouillon growth is as vigorous in the bulb as it is in glucose, but there is no development in the closed branch nor any gas production. In 48 hours the media in the bulb of the fermentation tube shows a decrease in its acidity, and after 3 weeks' development the reaction becomes 1 per cent — to phenolphthalein. No pigment formation or

Description of Plate XXXVIII.

Fig. 1. From a cover-glass preparation made from 24-hour-old bouillon tube No. 9, cow No. 4, showing the bacillus in pairs with peripheral stain. Zeiss 2 mm. oil-immersion objective, No. 6 compensating ocular. Enlarged 6 diameters.

Fig. 2. Cover-glass preparation from gelatin plate 48 hours old and stained with Loeffler's alkaline methylene blue. Zeiss 2 mm. oil-immersion objective, No. 6 compensating ocular. Enlarged 6 diameters.

Description of Plate XXXIX.

Fig. 1. Cover-glass preparation of a 36-hour-old agar-agar culture, obtained from the brain of cow No. 6. Zeiss 2 mm. oil-immersion objective, No. 6 compensating ocular. Enlarged 6 diameters.

Fig. 2. Cover-glass preparation of splenic pulp from cow No. 8, showing the bacilli and their arrangement in pairs. Preparation colored with Loeffler's alkaline methylene blue. Drawing made with camera lucida at stage level by using Zeiss 2 mm. oil-immersion objective and No. 4 compensating ocular.

Description of Plate XL.

Fig. 1. Cover-glass preparation of 24-hour growth of the bacilli on agar-agar, stained by Löwit's method to show the flagella. It will be noticed that numbers of flagella have been torn from the bacilli. Outlined at stage level by camera lucida with Zeiss 2 mm. oil-immersion objective and No. 6 compensating ocular.

Fig. 2. Cover-glass preparation of blood from pigeon No. 1, showing the bacilli scattered throughout the film. Stained with Loeffler's alkaline methylene blue and eosin. Camera-lucida drawing made with 2 mm. oil-immersion objective and No. 4 compensating ocular at stage level.

Description of Plate XLI.

Section of liver of rabbit No. 196, which died from the effects of the experimental disease after a period of five days. Stained with Loeffler's alkaline methylene blue. Camera-lucida drawing made with Zeiss 8 mm. objective and No. 4 compensating ocular. Notice the extensive tissue necrosis and the irregular involvement of the hepatic cells.

Description of Plate XLII.

Section of liver of cow No. 8, which died from the spontaneous disease after running a chronic course. Stained with methylene blue and eosin. Camera-lucida drawing made with Zeiss 8 mm. objective and No. 6 compensating ocular.

The explanation of the letters applies to both figures.

a. Areas of coagulation necrosis.

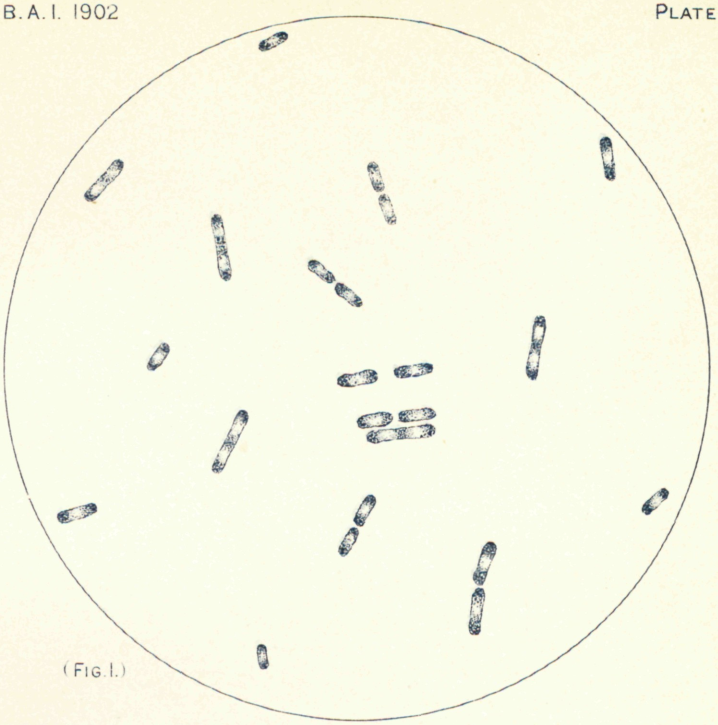
b. Polymorphonuclear leucocytes.

c. Fragmented nuclei of hepatic cells.

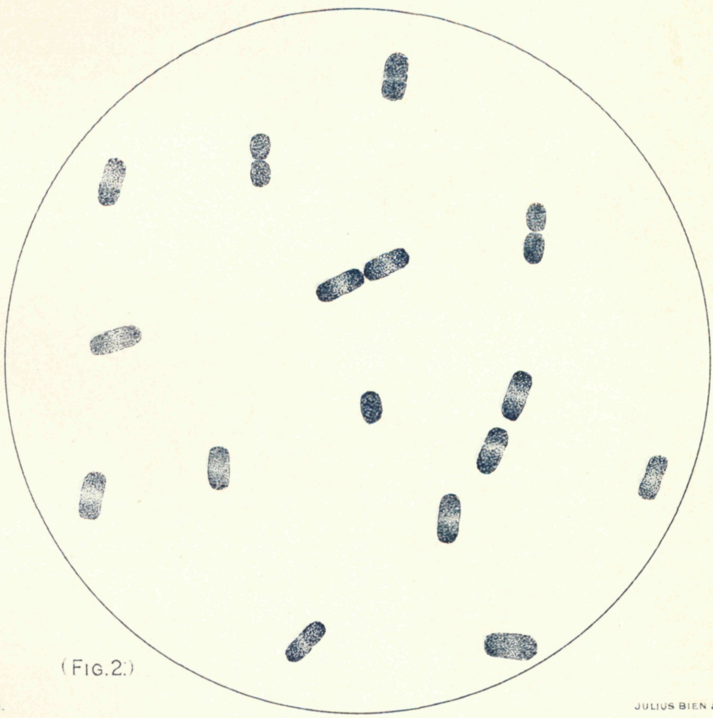
d. Fibrinous reticulum.

e. A few spindle cells assuming a connective-tissue aspect.

f. Notice the tendency of the remaining hepatic cells to conserve their relative positions.



(FIG. I.)



(FIG. 2.)

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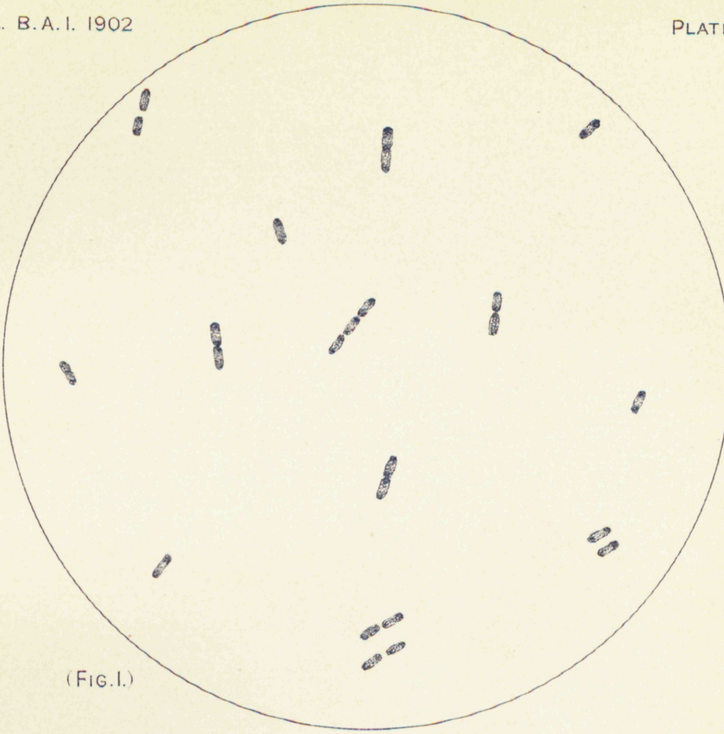
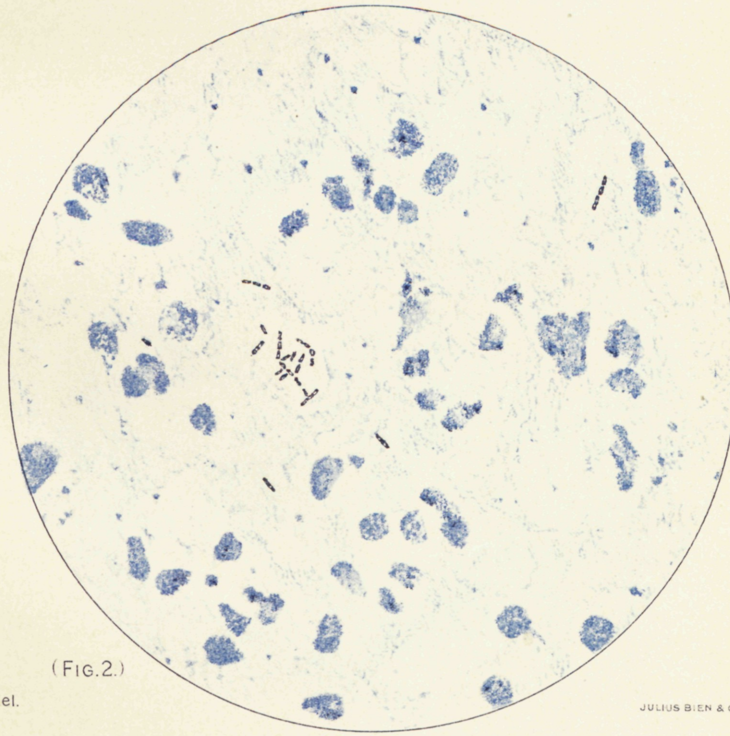
APPEARANCE OF THE BACILLUS IN BOUILLON (FIG. I.) AND IN GELATIN (FIG. 2.)



(FIG. I.)



(FIG. 2.)

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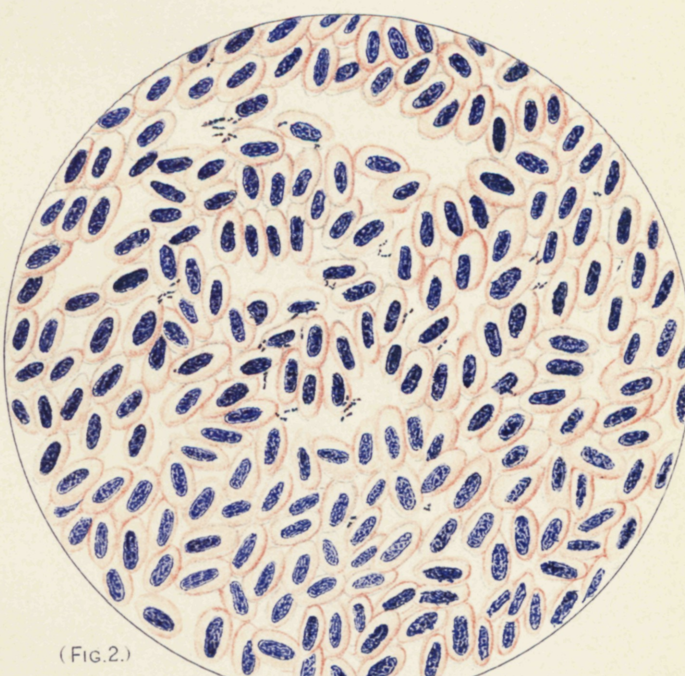
APPEARANCE OF THE BACILLUS ON AGAR (FIG. I.) AND IN SPLENIC PULP OF COW NO. 8. (FIG. 2.)

(FIG. I.)



(FIG. 2.)

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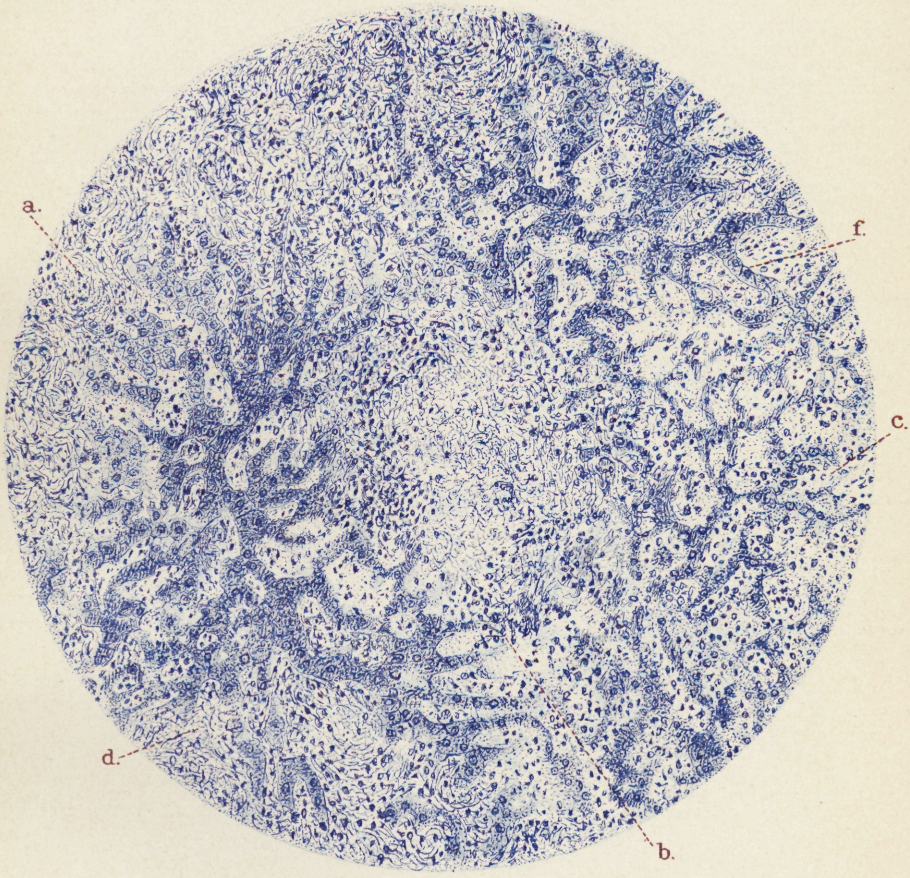
PERITRICHIC ARRANGEMENT OF THE FLAGELLA (FIG. I.) AND BLOOD FROM PIGEON SHOWING INFECTION WITH BACILLUS (FIG. 2.)



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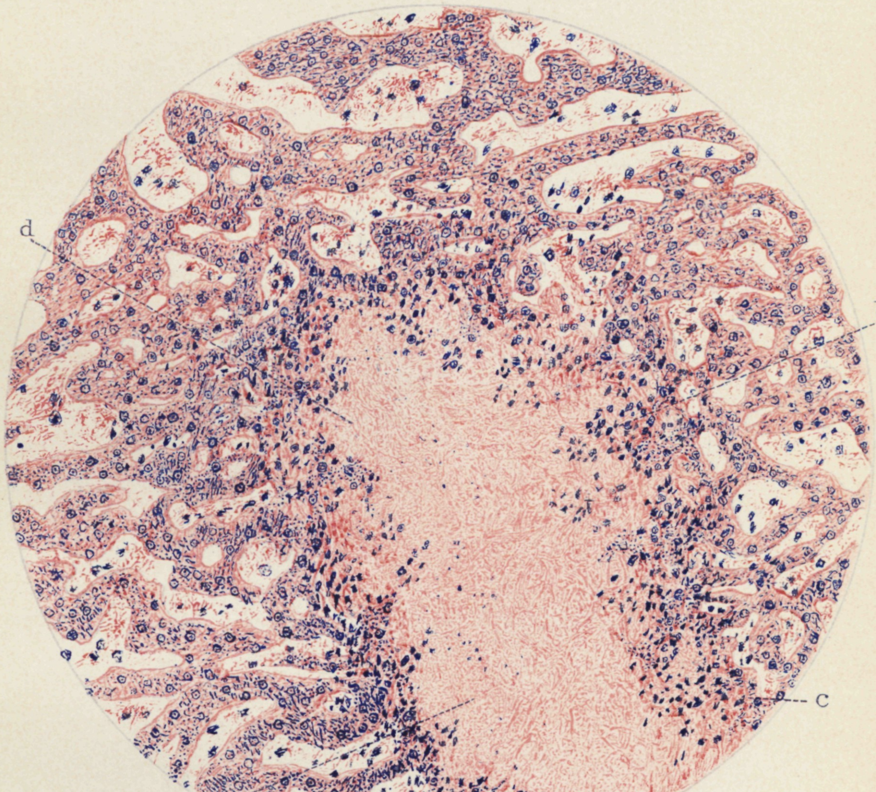
MICROSCOPIC LESIONS IN EXPERIMENTAL DISEASE OF RABBIT.



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MICROSCOPIC LESIONS OF LIVER IN SPONTANEOUS AFFECTION OF COW.

development of any definite or characteristic odor was noticed in any of the cultures examined.

Indol and phenol.—In Dunham's solution no indol reaction was observed by the addition of sulphuric acid and sodium nitrite after the method of Kitasato. When hydrochloric-acid distillate of a 10-day-old culture was tested for phenol and indol, no reaction was obtained in either case (Weyl-Lewandowski).

Temperature requirements.—In suitable media a fair growth is observed in from 20 to 24 hours at 19° to 22° C., but a profuse growth takes place within 12 hours at 37° to 38° C. Culture media inoculated with this bacillus and kept at a temperature of from 12° to 16° C. became fertile, but at 41° C. the tubes remained sterile in every instance.

Thermal death point.—When tested for the thermal death point it was found that a few drops of a 24-hour bouillon growth distributed in bouillon tubes and exposed in a water bath to a temperature of 54° C. for varying lengths of time showed growth up to 45 minutes. At this temperature no growth was obtained. An exposure of 12 minutes in the water bath at 58° C. sufficed to produce sterility, while at 70° C. bouillon tubes which were exposed for 3 minutes remained clear.

Effect of desiccation.—When empty sterile tubes which had been inoculated with two platinum wire loopfuls of a bouillon culture and dried overnight in an incubator were subsequently exposed to the effect of diffuse light for 2 days, the vitality of the organism was still retained after bouillon had been added and the tubes incubated at a temperature of 37° C. Tubes similarly prepared and exposed for 3 days or more failed to show any development of the bacillus after the usual method of incubation.

Effect of low temperature.—Bouillon cultures recently inoculated were subjected to an exposure in a freezing mixture twice daily for 3 days in an ice chest. These tubes became fertile when subsequently incubated at 37° C.

Action of disinfectants.—Two platinum wire loopfuls of a 24-hour bouillon culture were added to a 1 per cent solution of carbolic acid. When subsequently inoculated into fresh bouillon tubes it was found that an exposure of 7 minutes did not kill the organism, but after 8 minutes growth failed to appear. Bouillon tubes similarly inoculated with the bacillus after an exposure of 14 minutes to a 0.4 per cent solution of formalin remained sterile. A 1 to 10,000 solution of bichloride of mercury killed the organism in 30 seconds, while in the strength of 1 to 75,000 no growth occurred in 6 minutes. When exposed to a 10 per cent solution of zinc chloride no development was observed after a contact of 5 minutes. Growth was prevented when subjected to a 1 to 500 solution of permanganate of potassium for 1 minute. In a strength of 1 to 5,000 no development was observed

after a 3-minute exposure. A 0.12 per cent solution of limewater had a germicidal effect after an exposure of 1 hour, but a profuse growth was observed in tubes where the bacillus had been subjected to a three-fourths hour exposure. Limewater in the strength of a 0.08 per cent solution killed the organism in 3½ hours. These solutions were used at room temperature (21° C.).

PATHOGENESIS.

When the pathogenicity of the above-described organism was tested upon experimental animals, both by inoculation and ingestion, an acute toxemic septicemia was produced accompanied by a gastro-enteritis, insular areas of coagulation necrosis in the liver and spleen, and petechial hemorrhages in various tissues.

EXPERIMENTS ON GUINEA PIGS.

Intraabdominal inoculations.—When a dose varying in size from 0.1 to 0.5 c. c. is injected into the abdominal cavity, death occurs in from 4 to 9 days. The postmortem examination shows the principal lesions to be in the liver, lungs, and spleen and resemble closely those produced by the hog-cholera bacillus. The lungs appear to be hepatized, as in catarrhal pneumonia, while the heart is usually normal, although petechial extravasations have been observed on the muscle wall. The liver is somewhat enlarged, and shows the characteristic areas of coagulation necrosis so frequently observed as a result of the bacilli of this group. The spleen is enlarged and congested. The kidneys are likewise inflamed, but of a normal size. A semiorganized plastic film covers the liver and may be seen between the loops of the intestines. The lymphatic glands are sometimes found to be edematous and hemorrhagic or even undergoing caseous degeneration. The intestinal blood vessels are engorged.

Subcutaneous or intramuscular inoculations.—A dose of 0.05 to 0.30 c. c. injected into the muscles or under the skin of the hind leg produced death in from 5 to 11 days. Considerable tumefaction occurs at the point of inoculation, and the animal usually shows extreme lassitude within 24 hours of death. On postmortem examination the inoculated limb appears swollen. A necrotic area is observed at the site of injection, with hemorrhages into the surrounding muscular tissue. The blood vessels of the heart appear injected, and petechial hemorrhages may be observed under the epicardium. The lungs may show small hepatized areas or may be normal. The spleen is enlarged and congested, and in one instance (guinea pig No. 1445) numerous pin-point areas of coagulation necrosis could be seen scattered over its entire surface. Liver may show fatty degeneration or several grayish yellow areas of necrosis. Kidneys are apparently normal. Lymph glands are frequently found enlarged and hyperemic.

Feeding experiments.—A quantity of oats over which had been

poured 40 c. c. of a bouillon culture of this bacillus was fed to three guinea pigs that had been deprived of food for 24 hours. This ration was readily devoured and resulted in the death of the animals after 7, 8, and 13 days. The postmortem examination showed practically the same lesions, and for illustration the following case will be quoted:

Guinea pig No. 1789, fed on June 6, was found dead on June 13. The autopsy showed the lungs to contain numerous punctiform hemorrhages scattered through their substance. Heart apparently not involved. Liver showed a fatty degeneration. Spleen contained several areas of coagulation necrosis and numerous points of hemorrhage on its surface. Kidneys were slightly paler than normal. A thickening and congestion of the pyloric mucous membrane of the stomach was present, while the small intestines, cecum, and colon showed the effects of the germ, especially in the Peyer's patches, which were greatly swollen and infiltrated, and those in the ileum and about the ileocecal valve were ulcerated. The blood vessels were all apparently injected and there was the general appearance of an intense fever. Cultures made from the above-described lesions in the guinea pigs of these experiments showed numerous colonies of the specific bacillus.

EXPERIMENTS ON RABBITS.

Intravenous inoculations.—When rabbits are injected by this method, with even so small a quantity of bouillon culture as 0.01 c. c., death occurs in from 5 to 7 days. When 0.5 c. c. is used, death usually follows in from 24 to 48 hours, while 0.1 c. c. kills in about 4 days. Before death the rabbits appear listless, refuse their food, tremble perceptibly, and have accelerated respirations. On postmortem examination the lungs appear slightly congested. The coronary veins are injected, while petechial hemorrhages and large extravasations are apparent in the muscular tissue of the heart under the epicardium. The liver appears about normal in size, but contains numerous small patches of coagulation necrosis in some cases, while in others it is pale and shows fatty degeneration. The gall bladder is inflamed and distended with thick bile. The spleen is enlarged and congested. The kidneys are usually in an apparently normal condition, although they may be found engorged. Petechial spots and inflamed areas have also been observed on the mucous membrane at different places along the intestinal tract, but principally of the stomach and the small intestines.

Subcutaneous inoculations.—A dose of from 0.1 to 0.5 c. c. injected under the skin of the hind leg produces death in from 48 hours to 7 days. The resulting lesions were in the majority of cases similar to those above described with a necrotic area surrounding the point of inoculation. The lungs were hepatized in patches. The heart showed petechial extravasations. The spleen appeared swollen and inflamed.

The liver contained areas of coagulation necrosis. The kidneys showed in most cases a pallid cortex with an apparently normal medulla. In one instance the kidneys presented several ecchymotic hemorrhages under the capsule and the mucosa of the bladder showed intense inflammation. The intestinal lesions do not differ from those produced by intravenous injections.

Intraabdominal inoculations.—Two rabbits inoculated with 0.1 and 0.5 c. c. of 3-day-old bouillon culture died on the fifth and second day, respectively. The postmortem appearance was similar to that caused by intravenous inoculations with the additional lesion comprising a thin plastic deposit covering the abdominal viscera.

Feeding experiments.—After fasting for 24 hours rabbits Nos. 361 and 362 were fed a quantity of oats moistened with 60 c. c. of a fresh bouillon culture. Death occurred on the seventh and sixth day, respectively, after the exposure. The postmortem appearance differed but slightly from one another, and therefore the protocol on No. 361 will be briefly recorded:

Lungs contain numerous petechial hemorrhages both on the surface and scattered through their substance. Epicardium also shows several hemorrhages. Liver seemingly engorged with blood and contains several localized grayish yellow areas of coagulation necrosis. (The liver of rabbit No. 362 showed the nutmeg appearance.) Kidneys injected. Spleen much enlarged and darkened. Stomach at its pyloric portion is intensely inflamed. The duodenum is very much congested and patches of inflammation extend throughout the entire intestine. The Peyer's patches are greatly swollen and infiltrated. The rectum shows numerous punctiform hemorrhages beneath the mucous membrane. All else apparently normal. The causative bacillus was readily recovered from the various organs in the rabbits of the above experiments.

EXPERIMENTS ON RATS.

Two young house rats were inoculated subcutaneously at the base of the tail on February 21 with 0.1 c. c. of a 36-hour-old bouillon culture from the spleen of sheep No. 43. These rats died within a few hours of each other on February 26 after a period of about 4½ days. The lesions observed in both animals on postmortem examination were a greatly swollen and engorged spleen and a slightly enlarged and congested liver. All other organs were apparently normal. Pure cultures were obtained from the heart's blood, the liver, and the spleen of both these animals.

EXPERIMENTS ON CHICKENS.

Fowls were inoculated both by intravenous and intramuscular inoculations with 0.5 c. c. of a fresh bouillon culture. Nothing was observed during the following 3 months to indicate that the chickens

had been injected and they were then chloroformed. In all but one the postmortem showed absolutely healthy birds, and in this one case the chicken was greatly emaciated without any true lesion in the organs or tissues. Media inoculated with the blood and various organs of this fowl remained sterile in all cases.

EXPERIMENTS ON PIGEONS.

Intravenous inoculations of 0.4 c. c. of a fresh bouillon culture killed a pigeon in 80 hours without producing any noticeable symptoms. The lesions observed on postmortem examination comprised a very greatly reddened appearance of the muscular tissue and all the organs with the exception of the lungs seemed to be engorged with blood. The specific organism was obtained from the heart's blood. (Pl. XL, fig. 2.)

Intramuscular inoculation of 1.5 c. c. of a similar culture into pigeon No. 2, resulted in death in 5 days. The bird appeared dull and listless the day following the injection and remained on its perch constantly without partaking of any food. The postmortem examination showed the pectoral muscles within a radius of three-fourths of an inch from the site of the injection to have undergone tissue necrosis, giving one the impression of having been cooked. The muscles surrounding this dry, pallid, lusterless area were moist and reddened, furnishing a marked contrast. The lungs were slightly hepatized in localized areas. The liver was swollen and engorged with blood. The intestines were inflamed in patches, especially the duodenum and ceca. All other organs normal. Pure cultures were recovered from the heart's blood and the necrotic muscular tissue.

Another bird (No. 3) was similarly inoculated in the right pectoral muscle with 0.3 c. c. of the same culture on April 28, without producing any apparent effect. This same pigeon received 1 c. c. of a virulent culture intramuscularly in the left pectoral region on June 9 and the next day became very ill. It refused its food, seemed languid, and would remain in a semicomatose condition in a corner of its cage with feathers rumpled for hours at a time. Diarrhea appeared on the third day. After the eighth day the bird began to improve and apparently recovered. On July 10 the pigeon was chloroformed for postmortem examination. After picking there were observed on both sides of the sternum at the site of the previous inoculations two dark dried-appearing masses, each projecting from beneath a flap of skin. They were readily removed, and upon examination were found to be sphaceli of muscular tissue, resulting from the injection of the specific bacillus. A tissue necrosis was probably set up, and, owing to the great resistance of the bird to the injected material, a reaction of the surrounding tissue followed, succeeding gradually in removing the necrotic mass after it had been separated from the healthy tissue by a process of softening. The right sphacelus was about the size of a date

seed and projected from the skin two-thirds of its length. The left sphacelus was three times as thick as the former and twice as long, and extended only one-half inch from the skin in the form of a dark warty growth. The internal organs were apparently normal and the media inoculated from them remained sterile.

EXPERIMENTS ON DOGS.

Intravenous inoculations.—Small black terrier (No. 1), weight 23 pounds, was inoculated into the ear vein with 1 c. c. of a bouillon culture after one passage through a rabbit. Within one hour the dog began to vomit and purge freely, and seemed very much dejected. Salivation was excessive. On the day following the animal remained quiet and refused all food. The purging still continued, and the dog appeared to be losing flesh. Temperature, 104.1°. After the fifth day recovery seemed to take place, the appetite returned, and the dog regained its normal appearance. Six weeks later it was again inoculated with 3 c. c. of a bouillon culture, and again presented very much the same symptoms, also followed by recovery. After an interval of four weeks the dog was reinoculated with 5 c. c. of a bouillon culture into the ear vein, and again the results were similar but not so severe and the animal made a quick recovery. Blood taken from this animal was found to have an agglutinating effect upon the cultures of hog cholera as well as with the bacillus under consideration in a dilution of 1 to 150.

Black dog (No. 2), weight 35 pounds, was inoculated intravenously at 2 p. m., June 11, with 3 c. c. of a 4-day-old bouillon culture. The dog began to salivate freely in about one-half hour. At 3.10 p. m. the animal vomited, and was purging quite freely, continuing for several hours. June 12 the animal vomited occasionally, refused all food, and appeared very sick, with a temperature of 104.9° F. June 13 still refused all food, but drank occasionally of water; purging a little; seemed very dejected, and was lying down most of the time. June 14, animal still refused to eat anything, but occasionally drank a little water; remained recumbent most of the time; occasionally moved about uneasily; animal presented a "tucked-up" appearance. June 15, found dead at 3 p. m. Placed in ice chest until Monday, June 16. The dog had become perceptibly thinner, the carcass weighing but 29½ pounds.

Autopsy.—Lungs slightly congested. Heart apparently normal. Liver presents a nutmeg appearance, evidently a fatty degeneration of the cells. Spleen shows several areas of congestion. Kidneys are both engorged with blood. Stomach mucosa slightly congested. The external coat of the intestines shows congested areas along its whole course. The intestinal mucosa presents areas of inflammation in the ileum, but not of an extensive nature. All other tissues appear normal. Cultures of the specific bacillus were obtained from the affected organs.

EXPERIMENTS ON SHEEP.

Intramuscular inoculation.[a]—Sheep No. 61 was inoculated on December 11, 1901, with 1 c. c. of a 2-day-old bouillon culture from the heart's blood of rabbit No. 193, which had been injected with the bouillon culture from the heart's blood of cow No. 4. Death occurred during the night of December 20 after a period of 9 days.

Postmortem showed the heart to be pale and flabby without any observable extravasations in the heart muscle or on the pericardium. The lungs were normal externally, but on section the smaller bronchi were found to contain a few parasites (*Strongylus filaria*). The liver was pale and slightly enlarged with rounded borders. The spleen appeared slightly swollen with the pulp congested. The surface of the spleen showed indistinct diffuse petechial hemorrhages. Kidneys apparently normal. Stomach and intestines appeared normal, but several tapeworms (*Moniezia expansa*) were found in the large intestines. Cultures of the bacillus under consideration were obtained from the liver and spleen in this case.

Intravenous injection.—Sheep No. 43, born at the Bureau Experiment Station in the spring of 1900, was injected into the right jugular vein on January 7, with 1 c. c. of a 3-day-old bouillon culture from the spleen of rabbit No. 161. On January 9 the animal appeared spiritless, respirations became accelerated, and the sheep refused its food. The temperature on this day was 105.4° F. The symptoms became more aggravated until January 12, when the animal died at 2 p. m., after showing a morning temperature of 104.2° F.

Postmortem: The heart is very flabby and congested. No petechia in the heart muscle. Pericardium contains reddish serous fluid. Both right and left lung very much congested. Liver pale. Spleen much enlarged, pulp dark and fairly firm. Surface of the spleen shows ruptured capillaries, more diffuse and larger in size than in the former animal. Kidneys very much congested and softened. The mucosa of the abomasum is slightly injected. The mucous membrane of the duodenum is very much congested and swollen. Throughout the intestinal tract are caseous nodules produced by the *Œsophagostoma columbianum.* The bladder is well distended with albuminous urine. Cultures were obtained from the various organs and also from the blood.

EXPERIMENTS ON HOGS.

Subcutaneous injections.—On February 28, 1902, hog No. 245 was injected subcutaneously on the inside of the right thigh with 2 c. c. of a 3-day-old bouillon culture from the heart's blood of rabbit No. 196, which had received a culture from the brain of cow No. 5. Weight

[a] We are indebted to Dr. E. C. Schroeder, superintendent of the Bureau Experiment Station, Maryland, for the injection of, and antemortem notes on, the sheep, hogs, and calves in this investigation.

of hog, 32½ pounds. The animal seemed to be in excellent spirits the next day, but had a temperature of 104°. This fever fluctuated until March 16, when it reached its highest point, 104.6° F., with no other sign of the disease apparent, and then gradually subsided until March 29, when it regained a normal temperature and the animal was pronounced healthy.

Intravenous injection.—The above animal (hog No. 245) was injected intravenously on April 7, 1902, with 5 c. c. of a 4-day-old bouillon culture. April 8, the animal is dull and languid, with accelerated respirations. Temperature a. m., 102.1°; p. m., 103°. April 9, the animal died this morning.

Postmortem examination: Inspection reveals a diffuse redness over the surface of the abdomen and inner aspect of the legs. Muzzle and mucous membrane of the mouth somewhat reddened. On cutting through the skin and adipose tissue numerous capillary hemorrhages can be observed scattered through the fat. The heart muscle shows four or five petechial hemorrhages about 1 mm. in diameter beneath the epicardium. The lungs present several small areas of red hepatization in all the lobes excepting the left cephalic. The liver exhibits hemorrhagic spots and mottled markings of beginning necrosis distributed over its surface. The spleen is normal in size and appearance. The stomach mucosa is congested with one eroded area about the size of a silver 10-cent piece near the pylorus. The intestinal mucosa is slightly inflamed about the region of the ileocecal valve. The kidneys are congested and show yellowish white areas throughout their structure which is probably also a beginning necrosis. Several ecchymotic spots are seen under the capsule when minutely examined. A few petechial hemorrhages appear on the parietal pericardium. The lymphatic glands throughout the carcass are intensely inflamed and swollen. The characteristic bacillus was obtained from the various organs and the blood by the usual methods.

On February 28, 1902, hog No. 248 was injected intravenously with 1 c. c. of a bouillon culture marked blood of rabbit No. 196 (February 25, 1902). The hog weighed 29 pounds and harbored many lice. On the following day the animal seemed depressed and showed a temperature of 104.2° in the morning and 106° in the evening, but on the succeeding days the temperature was but slightly above normal. On March 11 the animal showed an extreme lassitude and was scouring badly, having a morning temperature of 103° and an evening temperature of 105.4°. It died on March 20.

Postmortem: Carcass in good condition. On inspection the skin over the whole abdominal surface and on the inner aspect of the fore legs and thighs presents a diffuse redness. The muzzle shows a dark red or purple discoloration. The ears are not swollen or inflamed. The conjunctiva appears congested while the oral mucosa is purple in color. On opening the animal a few extravasations appear, as if there

are slight capillary hemorrhages into the muscular and adipose tissues. The mucous membrane of the epiglottis is slightly congested, while the trachea and bronchi are apparently normal. The lungs, pericardium, and heart give a similar impression of health. The liver is somewhat injected. Spleen is very much enlarged and congested, and extends clear across the abdomen. The kidneys are engorged somewhat, but do not show pin-point hemorrhages. The sublumbar, mesenteric, mediastinal, prescapular, superficial, and deep inguinal lymphatic glands are all much enlarged and reddened. The stomach mucosa appears intensely inflamed and eroded in four localized patches. The intestinal mucous membrane is slightly congested in areas, involving the agminated and solitary follicles, and at the ileocecal valve a somewhat ill-defined inflammatory area is noticed. No blush or petechial hemorrhages on the pleura or peritoneum. The specific bacillus was recovered from the various tissues of this animal.

Feeding experiments.—On April 7, 1902, hog No. 246 was fed 70 c. c. of a 4-day-old bouillon culture mixed with mill feed. All was eaten at once. On April 8 the animal was again fed the same amount of this culture mixed with mill feed, which was devoured immediately. April 10, 1902, the hog is scouring a little, but otherwise seems to be as well as usual. April 16, the animal is still scouring very badly. Appetite very poor with a temperature of 104.2°. April 18, still scouring severely and is becoming thin and weak. Temperature 101°. April 19, hog died this morning.

Postmortem: Weight, 31½ pounds. It being a black hog evidence of inflammation or reddening of the skin does not appear, but on scalding and shaving all the characteristic skin lesions of hog cholera are discernible. On opening the animal the first appearance of pronounced lesions are in the lungs, which show both of the cephalic lobes and one or two small areas in each of the principal lobes to be pneumonic. The mesenteric lymphatics are congested and swollen, but all the other lymph glands look normal. On opening the stomach an intense inflammation and ulceration is seen at the pyloric end. The small intestines show an inflamed condition of the solitary follicles and Peyer's patches throughout their entire extent with superficial sloughing in several instances. The mucous membrane of the cecum is necrotic in patches and the mucosa of the large intestine appears very much engorged. The liver does not show any evidence of necrosis, but is slightly congested. The spleen appears but slightly enlarged and otherwise looks quite natural. The kidneys show several petechiæ under the capsule more plainly than in the other cases. Pure cultures of the bacillus under consideration were obtained from the blood and all the organs.[a]

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[a] In these experiments the hogs of one litter were used and the experiment controlled by check pigs of the same litter which were placed under similar external influences and which have remained healthy up to the present writing.

EXPERIMENTS ON CALVES.

Intravenous inoculations.—Heifer calf No. 262, 5 months old, was injected at 2.15 p. m., May 14, 1902, with 5 c. c. bouillon culture 24 hours old obtained from the blood of pigeon No. 2, which had been inoculated directly with bouillon culture from brain of cow No. 4. May 15, the animal is spiritless, walks with uncertain gait, appetite is poor, and is scouring. May 16, 9 a. m., not so well as yesterday, respirations labored, refuses food, is able to walk but staggers when she does so. May 17, 8 a. m., found dead.

Temperature table.

Date.	A. M.	P. M.
1902.	°	°
May 14	....	102.4
May 15	105	107.4
May 16	108	108.2

Postmortem: The pathological alterations present are essentially those of acute generalized septicemia. The mucous membranes of the eyes, mouth, and nose are congested and covered with ecchymotic hemorrhages. The subcutaneous, muscular, and adipose tissues present a few widely scattered areas of extravasations. Pleural cavity contains a considerable quantity of a pale straw-colored exudate. The parietal pleura is inflamed and numerous adhesions to the pulmonary pleura are observed. The pleural surface of the diaphragm is slightly inflamed and shows numerous pin-point hemorrhages. The mucous membrane of the larynx and pharynx is of a purplish color, while that lining the trachea appears normal. The lungs are edematous and greatly engorged with blood. The posterior mediastinal lymph glands are enlarged and injected. The pericardium is slightly thickened and shows many petechial areas. The heart presents this same variety of hemorrhage, both under the endocardium and epicardium. The thymus gland is swollen and congested and contains numerous isolated and diffused hemorrhagic extravasations. The abdominal cavity contains a large quantity of a blood-stained exudate. The parietal peritoneum is inflamed only in the region covering the abdominal muscles. Liver is enlarged and hyperemic with well-rounded borders. The capsule shows numerous punctiform hemorrhages, which are also observed in the parenchyma of the organ. The gall bladder contains blood-tinged bile. The kidneys are normal in size, but slightly hyperemic. The bladder presents several petechial spots on its external wall. The spleen shows localized and confluent patches of sanguineous extravasations located beneath the surface of the capsule. The organ is normal in size, but slightly injected, and a fibrous exudative

layer is seen over its gastric surface attaching it to the stomach. The mesentery and omentum contain numerous ecchymotic patches. Rumen and omasum are apparently normal. The mucous membrane of the abomasum is intensely inflamed and swollen. Throughout the entire length of the small intestines the mucosa is thickened and hyperemic, with numerous hemorrhagic points upon its surface. The only contents observed in the small intestines was a blood-stained mucus. The serous coat of the large intestines has an injected appearance. The mucosa is but slightly involved, except in two or three localized areas, where it is deeply inflamed. The contents consists of a diarrheal fluid mixed with blood and mucus. The mesenteric lymph glands are enlarged and congested. The specific microorganism was recovered in pure cultures from the heart's blood and affected organs.

Subcutaneous inoculations.—Heifer calf No. 258, 3 months old, was injected subcutaneously in front of left shoulder on April 12, 1902, with 5 c. c. of a bouillon culture marked "Hog 245, blood, April 9, 1902." April 14, 1902, was very sick yesterday (Sunday), respirations labored and accelerated, refused food, and was apparently in great distress. Extensive local reaction. Is much better this morning, appetite fairly good, and appears to be bright and lively. Has a firm swelling, 6 by 8 inches in area and by 2 inches in height, at seat of injection. This swelling was much larger yesterday. April 15, 1902, appears to be bright and lively. The swelling at seat of injection is about 4 by 6 inches in area by 2 inches in height. April 16, 1902, the local reaction is slowly subsiding; animal appears to be bright and lively. April 19, 1902, animal appears to be in as good condition as before injection.

Temperature table.

Date.	A. M.	P. M.
1902.	°	°
Apr. 14	----------	105.6
Apr. 15	104.6	105.4
Apr. 16	104.2	103.4
Apr. 17	103.4	103.6
Apr. 18	102.6	103.6
Apr. 19	102.4	103.0
Apr. 20	102.6	102.6
Apr. 21	103.0	103.4
Apr. 22	103.0	103.0
Apr. 23	103.4	103.2
Apr. 24	102.0	102.0

Feeding experiments.—On May 17, 1902, the above animal (heifer No. 258) received 300 c. c. of a bouillon culture, marked "Pigeon 1, blood, May 14, 1902," which was introduced into the stomach by means of a rubber tube. May 19, 1902, no ill effects observed from

the culture drenching. May 22, 1902, scouring yesterday and to-day; seems to be all right otherwise. May 25, 1902, is well and scouring has ceased. May 31, 1902, is as well as usual.

Temperature table.

Date.	A. M.	P. M.
1902.	°	°
May 17	....	102.4
May 18	102.6	102.4
May 19	102.4	102.4
May 20	102.0	103.0
May 21	103.4	103.6
May 22	102.6	102.4
May 23	102.4	102.8
May 24	102.6	102.4
May 25	101.4	101.4

It was unfortunate that this feeding experiment should have been made with an animal previously inoculated with this bacillus, as it seems highly probable that a more or less immunizing effect was occasioned thereby.

PATHOLOGICAL HISTOLOGY.

Heart.—As already mentioned, the heart was the most constantly affected organ in the natural disease, and the lesions observed therein were reproduced occasionally in the experimental animals. The muscle fibers at first do not show any change, although their nuclei may be smaller and elongated. Later these fibers may become amplified, and in some cases show a granular or more frequently a fatty degeneration, and appear opaque or refuse to stain at all. Fragmentation of the nucleus may occur accompanied by a leucocytic infiltration and the appearance of a fibrinous reticulum. Hemorrhages are observed scattered irregularly through the tissue, and clumps of bacilli may be seen in many of these extravasations.

Liver.—This organ is the most extensively involved in the experimental disease, and presents the same general appearance in the majority of the experimental animals that lived a relatively long time. The two extremes are observed in the acute cases of the natural disease and in the rabbits which succumbed after a short period as a result of moderately large doses of the bacillus, on the one hand, and in the liver of cow No. 8, and the rabbits receiving minimum doses, on the other hand. In the specimens from animals that died quickly the only lesions that can be observed microscopically are those of parenchymatous degeneration accompanied by localized hemorrhagic extravasations. The liver cells are irregularly involved, but frequently those forming the periphery of the lobule appear affected, producing the microscopic picture of a "nutmeg" liver. The sec-

tions of liver tissue of those animals in which the disease has run a regular course may be observed to contain small localized areas of focal or insular necrosis appearing to the naked eye as poorly stained areas of variable sizes. When examined microscopically these foci are found to be areas of coagulation necrosis, involving from a single cell in an acinus to the entire number of cells in the lobule or many contiguous cells in other lobules. (Pl. XLI, fig. 1.) These necrotic foci may be located about the hepatic vein, in the portal spaces or within the acinus near its circumference. The first stages that are apparent seem to be the increased staining ability of the cell protoplasm, which shows greater opacity of a hyaline nature. The nuclei may continue to take the nuclear stain properly or they may remain unstained, forming a uniform homogeneous appearance with the protoplasm of their cells. Areas are frequently observed of this description which take the eosin stain profusely but still maintain their regular linear aspect. Finally dissolution of the cell protoplasm may occur and the nuclei undergo fragmentation (Karyorrhexis), forming, together with similar dissolution of other hepatic cells, a granular amorphous detritus, through which may be seen a reticulated fibrinous material, probably the remains of the cell protoplasm. Leucocytes are attracted by this necrotic mass and are seen encircling the areas, and they, too, are found to be degenerated, with their fragmented nuclei occupying a position among the detritus. The capillaries surrounding these areas are dilated and distended with red-blood cells and polynuclear leucocytes. Small clusters of bacilli are occasionally observed within the capillaries surrounding the necrotic tissue. In the liver of cow No. 8 the large yellow areas were found to be masses of necrotic tissue embedded in a fibrinous reticulum with phagocytic cells about the margin of the affected area. A tendency to regeneration was apparent, indicated by the few connective tissue cells that were present. (Pl. XLI, fig. 2.)

Spleen.—This organ in the experimental animals shows the changes of acute inflammation. The capsule appears slightly thickened and an increase in the interstitial trabeculæ is observed. The venous radicles are much dilated and contain red-blood corpuscles, plasma cells, and polymorphonuclear leucocytes. There is proliferation and desquamation of the endothelial cells lining these vessels, which produce occlusion of the lumen in many instances. Hemorrhagic extravasations are observed throughout the splenic pulp. The lymphoid elements of the spleen are materially increased and the Malpighian follicles appear enlarged. In this organ the bacilli appear in clumps situated usually in the venous lacunæ and form veritable emboli. Areas of coagulation necrosis were not infrequent, both in the follicles and in the splenic pulp.

Lungs.—As the lungs were not involved in any of the acute cases in this outbreak the microscopic examination of tissue is confined to the

experimental animals. Sections of the affected portions of the lungs show the pleura to be more or less thickened, with dilatation of the alveoli and smaller bronchi, which are found to contain an abundance of red-blood cells, together with desquamated epithelial cells, leucocytes, and at times a fibrinous exudate. The parenchyma of the lungs surrounding these spaces is inflamed. Irregular portions of the lungs appear hepatized and hemorrhagic infarctions have been observed.

Kidneys.—The kidneys show only the acute lesions of simple parenchymatous degeneration. The epithelial cells of the tubules are found to have undergone cloudy swelling. They may become proliferated and desquamated, resulting in the blocking of the lumen of the tubules with a granular, nonstainable detritus. Hyperemia is seen in the larger and smaller vessels of the cortex, and especially in the glomerular capillaries. In cow No. 8 this lesion was very prominent, accompanied with extensive areas of coagulation necrosis.

Intestines.—This microscopic examination was confined to the lesions in the small intestine of the rabbits, after fixation in Zenker's fluid. The histological changes consist in the necrosis of the epithelium of the mucosa, which is covered with leucocytes, red cells, and fibrin. The epithelium lining the villi and Lieberkuhn's follicles appear swollen and desquamated, and numerous phagocytes are observed surrounding these glands and about the blood vessels of the submucosa. The blood vessels appear greatly dilated, especially those of the submucosa, and extravasations are frequently observed extending into this tissue. The agminated follicles show a hyperplasia of the lymphoid elements and an infiltration of phagocytic cells. The tissue is hyperemic, and in one case a focal area of coagulation necrosis was observed, surrounded by an unusually large number of polynuclear leucocytes.

Technique.—For the fixation of the above-mentioned pathological tissues Zenker's fluid has given the best results. Lesions were also hardened in Flemming's mixture and in gradually increasing strengths of alcohol. The specimens were embedded in paraffin and celloidin. By far the clearest picture has been obtained by Unna's polychromatic methylene blue after the section has been previously stained in eosin. Other stains employed were Loeffler's methylene blue, hematoxylin, and eosin, Weigert's fibrin stain, and Bismarck brown and eosin.

COMPARISON WITH THE ORGANISM OF HOG CHOLERA.

In the preceding bacteriological investigation, including the experiments as to the pathogenicity of the organism isolated from this outbreak, the close affinity between the latter and the hog-cholera bacillus was frequently noted, and, after the inoculation experiments had been concluded, it was determined to ascertain the difference between these organisms by means of a parallel series of cultures. For this purpose

a representative variety of the hog-cholera bacillus was used which had been kept among our stock cultures for several years and which was isolated from a virulent hog-cholera outbreak in Illinois. This microorganism is the most virulent of the half dozen which are kept in this laboratory, and its pathogenicity has been continued by passage through rabbits every eight to ten weeks and by subinoculations into fresh culture media every month. Immediately before making the following comparison an endeavor was made to further increase the virulence of this hog-cholera bacillus by a series of inoculations of 4 rabbits. Death occurred very regularly in all these animals after a subcutaneous inoculation of 0.10 c. c., and always with the usual characteristic lesions. Owing to the great stability of individuality asserted by the various hog-cholera bacilli, it was deemed of unessential import, after the above treatment of the organism, that it should have been so long a period from its natural host. In the morphological comparison of the two germs on similar culture media it was found that the bacillus from cattle was the same width as the hog-cholera bacillus, but from 0.3 to 0.4 micron longer. The tendency to form in pairs, the inability to retain Gram's stain, the frequency of peripheral or bipolar staining, the peritrichic arrangement of flagella, and the activity shown in hanging-drop preparations are common to both organisms. In bouillon the growth of the cattle bacillus is more profuse and active, marked cloudiness occurring inside of 12 hours, with the formation of a delicate veil on the surface, together with a marginal zone attached to the side of the tube. In the hog-cholera culture the media is but slightly clouded, without pellicle or ring around the tube at the surface of the bouillon. After 10 days a heavier deposit is observed in the first case, but the reaction of the hog-cholera media at this time is of a greater alkalinity than the former.

In bouillon containing dextrose, lactose, or saccharose, the above differences in the appearances of growth are likewise noted, but in lactose and saccharose neither bacillus forms acid or evolves gas. In dextrose fermentation tubes the hog-cholera bacillus forms a less volume of gas and the ratio of $H:CO_2::2:1$, while in the case of the other bacillus the formula reads $\frac{H}{CO_2}=\frac{5}{3}$. The amount of acidity produced in dextrose bouillon by the latter organism is not so marked as that developed by the hog-cholera germ. In gelatin there is great difficulty in differentiating any constant variation either on plates or in stab cultures. Neither organism produced liquefaction. In agar plates the hog-cholera bacillus forms smooth, shiny colonies, which seem to have a thicker margin than center, while the bovine colony seems to be thicker through the center and narrowed at it's border. The latter colonies are also of a slightly wider diameter than the

former and of a more delicate shade of drab. The stab cultures can not be differentiated from each other. On potato the growth is practically similar, although that occurring as a result of the inoculation with the cattle bacillus seems to have a stronger brownish tint in old cultures.

In milk the effect upon the media is similar, but the length of time required for its production is shorter for the hog-cholera bacillus. The alkalinity of 2-weeks-old cultures is also greater in the latter instance. Litmus milk is at first changed by both of these organisms in a similar manner by being at first pinkish and then decolorized. Later, in the case of the hog-cholera bacillus, the blue returns and deepens as a result of the alkalinity produced, while with the bacillus from cattle the media never becomes as blue as it was originally, but assumes a bluish drab. In peptone cultures of the hog-cholera bacillus treated by Kitasato's method, no indol reaction was noted, and like results were obtained when the bacillus herein described was similarly tested. It will be seen from the following table that the organism under discussion is more sensitive to the action of heat, desiccation, and disinfectants than the hog-cholera bacillus:[a]

	Thermal death point.			Effect of desiccation.	Action of disinfectants.						
					Carbolic acid.		$HgCl_2$		$ZnCl_2$ 10 per cent.	$KMnO_4$ 1-5,000	Lime water 0.08 per cent.
					1 per cent.	1¼ per cent.	1-10,000	1-75,000			
Bovine bacillus.	54° C. 45 min.	58° C. 12 min.	70° C. 3 min	Death after 3 days.	8 min		½ min.	6 min.	5 min.	3 min.	3½ hrs.
Hog-cholera bacillus.	54.5° C. 1 hr.	58° C. 15 min.	70° C. 4 min	Death after 7 to 9 days.		5 min	2 min.	5 min.	15 min.	15 min.	4 hrs.

The pathogenesis of the two organisms vary to a considerable extent, and the hog-cholera bacillus is shown to be not only less virulent for the same species of animals, but also for a less number of species. As an illustration, Salmon and Smith were unable to reproduce the disease in the house rat, sheep, or cow with the hog-cholera bacillus, yet the bacillus above described proved to be highly virulent for all these species of animals. With the exception of pigeon No. 3, the various animals which showed the presence of the affection under consideration, on postmortem examination developed an acute hemorrhagic type of the disease, while the formation of the ulcers, or "buttons," so characteristic of chronic hog cholera, have not been observed. In the case of the pigeon above mentioned, the only postmortem evidence of the affection was the presence of the sphaceli at the seat of the two inoculations into the pectoral muscles. The principal significance that can be placed upon this regenerative

[a] See report entitled Hog Cholera, Bureau of Animal Industry, 1889, p. 87.

process is that the area of tissue necrosis resulting from the injections were too excessive to permit of their being absorbed, as was suggested by Smith in the case of the recovery of pigeons after an inoculation with hog-cholera bacilli. If this absorption does occur by the tissues as he has suggested it would indicate a less severe and less extensive alteration than was produced by the inoculation of the pigeon in question.

Despite the certain morphological, cultural, and pathogenic differences that were manifest between the two organisms, as above described, it seemed desirable to further ascertain if these variations were supported by others of a more or less discriminating character.

Filtrates and sterilized cultures.—With this in view, the filtrate from an 11-day-old bouillon culture was obtained by means of a Roux-Chamberland filter and injected subcutaneously into 2 guinea pigs and 2 rabbits, the dose varying from 1 to 3 c. c. No untoward results were observed as a result of these inoculations. A bouillon culture 2 weeks old was then made sterile by subjecting it to a temperature of 70° F. for ten minutes, as was subsequently proven by media inoculations. Injections were then made subcutaneously into the same number and species of previously inoculated animals as in the case of the filtrate and similar doses were administered. The results of both these experiments indicate that no toxicity was produced by the organism in broth that was sufficient to cause death.

Immunity.—The above animals were twice reinoculated with the same size dose of similar material as before, after intervals of six days in each case. A period of ten days was then allowed to elapse, after which rabbits Nos. 186 and 187, receiving 3 c. c. doses of the filtrate and sterilized bouillon culture, respectively, were inoculated with 0.05 c. c. of the hog-cholera and the latter with the same quantity of the bovine bacilli. These injections produced no apparent effect upon them. Two check rabbits that were injected with the same size dose of the virulent material died on the fifteenth and seventh day, respectively, as a consequence. The guinea pigs which had received 3 and 1 c. c. doses, respectively, of the filtrate and sterilized culture were likewise given 0.05 c. c. of the hog-cholera and cattle bacilli, with the result that the former guinea pig is still alive, while the latter died on the ninth day.

Interaction of agglutins.—While it has been distinctly proved by Durham and others that the clumping reaction is unsatisfactory for differential purposes, as it is not found to be universal, still marked variations between members of this group have been ascertained by this method when morphological and cultural tests failed to show any differentiation. When the serum of dog No. 1, of pigeon No. 3, and of rabbit No. 187 (immunized by injections of sterilized cultures) was diluted 1 to 150 and brought in contact with a 24-hour-old culture of the cattle bacillus, agglutination and loss of motility were marked and

appeared complete within twenty minutes to three-quarters of an hour. The sera of these animals had a similar effect upon a fresh culture of the hog-cholera bacillus. The blood serum of a rabbit (No. 164) was obtained on the third day following the inoculation of 0.01 c. c. of the bovine bacillus and treated as before, but no reaction was observed with either of the above organisms. It can thus be said as a result of these agglutination tests that the serum from an animal previously inoculated with the organism from this outbreak seemed to have a remarkably similar action both on this bacillus and on the hog-cholera organism. It was then thought desirable to record the reciprocal effect of the serum from a rabbit inoculated previously with 0.1 c. c. of the hog-cholera culture upon the bovine bacillus. A dilution of this rabbit's blood (1 to 150) was taken on the sixth day of its illness and brought in contact with the latter organism, but a comparatively slight effect only was obtained until about forty minutes had elapsed. At this time the motility had ceased, but the agglutinative reaction existed to a rather limited degree, and could not be considered as typical even after three hours of contact. In order to have a check on this result, a fresh culture of the hog-cholera bacillus was similarly treated. No apparent effect was observed for twenty-five minutes, after which the agglutination of the organisms and their loss of motility became very prominent, and in one hour and five minutes had been completed. Hanging-drop preparations from the cultures used in this reciprocal test were under observation during the experiment as controls on the agglutinative reaction.

Notwithstanding the fact that the hog-cholera serum did not have so marked a reaction on the cattle bacillus as upon its own bacillus, we are still under the impression that, when taken in conjunction with the excellent reactions observed with the sera of the animals inoculated with the bovine bacillus, a mutual and reciprocal agglutinative reaction exists between these organisms.

OTHER ORGANISMS OF THE ENTERITIDIS GROUP, WITH PARTICULAR REFERENCE TO ALLIED BACILLI ISOLATED FROM CATTLE.

It seems apparent from the above description of the morphological and biological characteristics of the organism under consideration that it belongs to the enteritidis group. Members of this group have frequently been found associated in causal relation with numerous outbreaks among many different varieties of animals; in fact, they have almost as varied a legion of hosts as the bacilli of hemorrhagic septicemia.

It is beyond the purpose of this paper to enter into a detailed description of the interrelation and the differences that have been found to exist among these various organisms. It suffices to say that, while in minor details dissimilarities have been found, there is a general and underlying resemblance which places them in one and the

same group. Since the isolation of the hog-cholera bacillus from swine by Salmon and Smith (1885), numerous other investigators have successfully proved the etiological relation between this organism or allied species and sundry diseases of animals.

Smith (1894) has shown that the bacillus *Typhi murium*, obtained by Loeffler, 1890, from an enzootic among white mice that were used at the Hygienic Institute at Griefswald for experimental investigations, belongs to this group.

Mereshkowsky (1895) isolated a similar bacillus from the ground squirrel.

Laser's bacillus, which was procured from a virulent outbreak among field mice in 1892, is likewise a member.

Eberth and Schimmelbusch (1889) obtained a kindred organism from an outbreak among ferrets in Germany.

In 1895 Moore found that a disease of pigeons was produced by a bacillus which he considers to be in this group.

Nocard in 1893 isolated an allied organism from a disease of parrots, which he named *Bacillus psittacosis.*

A bacillus belonging to the hog-cholera group has been obtained by Smith (1893) from the vagina of a mare after abortion.

Bacilli belonging to the enteritidis group have also been recovered from man as secondary invaders in yellow fever and as true etiological factors in meat poisoning.

In an able article by Reed and Carroll (1900) these writers compare the *Bacillus icteroides*, which Sanarelli isolated from yellow-fever patients, with the hog-cholera bacillus. Their conclusions from this comparison indicate that the bacilli are similar, and a more recent investigation of the etiology of yellow fever by the same authors, in cooperation with Agramonte (1901), seems to exclude the causal significance of the *Bacillus icteroides.*

The investigations of Durham (1901) have shown that the bacilli of Gärtner, Guenther, and others, observed in epidemics of meat poisoning, are members of this group.

Smith (1900) is likewise of the opinion that the poisonous meat bacilli described by Gaffky, Van Emergen, and Guenther are closely related to the hog-cholera organism.

Of far greater interest in connection with this article are the bacilli which have been directly obtained from lesions of cattle.

In 1888 Gärtner isolated the *Bacillus enteritidis* from the kidney and muscles of a cow which had been slaughtered after showing previous diarrhea. A postmortem examination of the cow showed the mucosa of the abomasum to be greatly engorged. An inflammation of the small intestine, which was also distended with gas, was present, while the solitary follicles and Peyer's patches were hyperplastic and injected. Other tissues appeared normal. It seems evident from the description of the bacillus of Gärtner, as well as by the bacteriological

examination of this organism by Theobald Smith (1894), that the *Bacillus enteritidis* is practically identical with the hog cholera bacillus.

Basenau in 1894 reported the presence of a microorganism in a cow which was slaughtered in Amsterdam. The animal had calved on March 7 and was brought to the abattoir and killed on March 19. It was supposed that the cow was suffering from parturient septicemia, but Basenau appears to be a little skeptical relative to this diagnosis. Even if the diagnosis had been certain, the presence of the bacillus was evidently a coincidence, as puerperal septicemia is not always produced by this organism, which Basenau calls *Bacillus morbificans bovis*. Again, it might have been present as a secondary invader, although the writers prefer questioning the correct diagnosis of the case. The bacillus is smaller than the one under consideration—1 to 1.2 μ long and 0.3 to 0.4 μ wide. It is motile, and produces gas in glucose bouillon but not in saccharose. A yellow moist growth occurs on potato. A pellicle forms on the surface of bouillon and milk is not coagulated. It is pathogenic for mice, rats, guinea pigs, rabbits, calves, and goats, while dogs and cats are refractory.

In 1897 Foulerton described a bacillus isolated from the kidney and muscle juice of an ox condemned as unfit for food. The intermuscular connective tissue contained a serous inflammatory exudate, and the muscle fibers themselves were dark red, moist, and of a gelatinous consistency. The lymph glands were injected and showed bloody extravasations. The kidney was congested and contained a number of petechial hemorrhages. The diaphragm likewise showed small hemorrhages in the muscular portion. The bacillus obtained was slightly smaller than the one under consideration. On cultural media the appearance of a faint yellowish brown growth on potato seems to be more feeble and uncertain than ours, although the growth of the latter on potato was by no means constant. The former bacillus does not form a pellicle on the surface of peptonized beef bouillon or even a tendency to adhere to the sides of the tube; otherwise the growth in this media is similar, as is the reaction. The difference in their pathogenic action is but slight. Foulerton's bacillus when inoculated into white rats caused them to be very ill for 3 days, but they then recovered. The only rats used in our experiments were house rats, and they succumbed in 4½ days. The subcutaneous inoculation of 2 c. c. of a bouillon culture into a calf caused a large swelling at the point of injection, high fever, profuse diarrhea, with synovitis of the stifle joint. The animal eventually recovered. The same quantity when injected into the jugular vein caused death in 5¼ hours without practically any lesions. A smaller dose, 0.75 c. c., caused the death of a 5-weeks-old calf in 8 days. The autopsy showed the lesions of septicemia, together with areas of necrosis in the lung and liver. The lungs were hepatized, with diffuse hemorrhages into the parenchyma.

The peritoneal cavity contained an excessive quantity of a serous exudate. Comparatively large doses (0.5 c. c.) when injected into rabbits killed them in 48 hours.

Thomassen, in 1897, published an article entitled "A new septicemia of calves," describing an outbreak among these animals in Holland. A farmer brought 10 calves to the veterinary school at Utrecht after having lost 5 in less than a month. The symptoms differed from those manifested by the cattle in this country principally in the presence of a nephritis and cystitis, causing the passage of small quantities of a blood-tinged albuminous urine. In the more severe cases, however, the symptoms were very similar, and consisted in cerebral complications manifested by epileptiform paroxysms and tonic convulsions (opisthotonos and trismus). The course of the disease was generally 5 to 6 days and terminated in death. The postmortem showed many points of resemblance to the disease under consideration. The lungs appeared to be normal, but the endocardium was covered with numerous areas of ecchymosis, especially surrounding the valves. The mucosa of the stomach contained many petechial areas. The serous membranes of the intestines showed a number of punctiform hemorrhages, while the mucous lining presented a smaller quantity of these petechiæ. On opening the cranium of the animals that developed nervous symptoms during life, meningitis was found with a cloudy exudate containing numerous bacilli. The cerebral substance was infiltrated and softened. In the calf disease the following lesions have not been observed in this country: A parenchymatous nephritis and an injection of the parenchyma of the spleen, which showed an increase of 5 to 10 times its normal size. The bacillus isolated from these various lesions presents characteristics which unquestionably place it in the enteritidis group. The principal points of difference from the organism which we have above described are the development of a thick veil on bouillon and the appearance of only a moist growth upon potato, similar to that produced by the typhoid bacillus. Gas is produced in glucose bouillon, but the quantity is small and consists, according to the author, of CO_2. A slight acid reaction is also observed. This organism is pathogenic for calves, rabbits, guinea pigs, white mice, and white rats. Goats and dogs are refractory. The latter were inoculated subcutaneously and intrapleurally. When calves are injected subcutaneously with from 1 to 2 c. c., death follows in from 4 to 6 days. The feeding of 100 c. c. of a culture killed a calf in 7 days. Rabbits die in from 1 to 8 days; guinea pigs, in 3 to 4 days; mice, in 4 to 14 days. The pathological alterations found on postmortem examination of these experimental animals were essentially the same as those produced in our experiments with the exception of greater macroscopic changes in the kidneys.

In 1893 Turner, as the State veterinarian of Missouri, investigated a disease among cattle, the description of which bears a strong resem-

blance to the disease herein described. The following symptoms were observed:

These are of gradual development. The disease, of whatever nature its operating cause may be, is manifested by purely nervous symptoms. At its incipiency the animals quiver and tremble as though palsied. They are unable to keep the head quiet, it being in a constant shake. Their eyes have a peculiar glassy look and fixity of expression. In their movements the animals simulate the gait of one affected with locomotor ataxia. This is during the first stages. As the disease progresses, the tremulous motion of the head continues, but with much exaggeration. The gait changes somewhat, the symptoms being similar to those of an animal suffering from laminitis. They increase in severity, and others appear. Then we have tetanic convulsions upon any excitement. Coordination becomes almost impossible, the animals falling over in a convulsion. The muscles of the whole body become tense and rigid, the limbs are entirely stiff, and should any movement be attempted the animal will topple over. The appetite is unimpaired and usually digestion is good. However, I have, since this outbreak, heard of some that had diarrhea. This latter symptom has not occurred in any that came under my own observation. These symptoms increase, involving all the muscles of the body, and the animals will pass off in one of the convulsions.

The postmortem examination of only one case is described, but no pathological alterations were observed macroscopically.

From the meager description of the outbreak it is impossible to draw any satisfactory conclusions as to its relation to the local disease, but the quality and severity of the symptoms, together with the scarcity of lesions found on postmortem, make it of unusual interest in connection with the latter affection.

DIFFERENTIAL DIAGNOSIS.

Whatever else might be said of this disease, the diagnosis and differential diagnosis do not afford the least of the difficulties encountered. In the first place, it is more than probable that the prodromal period will be passed without the symptoms of the trouble becoming manifest, and if any were observed there is no certain way of accurately interpreting them. Thus it is likely that the apparent symptoms of the onset of the disease will be sudden and severe, and at this time it is doubtful whether the true nature of the trouble would be suspected. Again, the first and succeeding symptoms presented are also the indication of several other affections entirely foreign to this one, and it will be only by the most critical judgment of the veterinarian that the disease can be diagnosed with any degree of accuracy without recourse to a postmortem and bacteriological examination. However, a diagnosis is essential before treatment and preventive measures can be carried out, and this subject will now be discussed, especially from the standpoint of a differential diagnosis.

Some of the conditions with which this disease may be confounded are anthrax, rabies, hemorrhagic septicemia, mycotic enteritis, and gastroenteritis due to mineral poisons.

In per-acute anthrax death occurs within a few hours without showing the various symptoms seen in this cattle disease. In acute anthrax where local lesions, as superficial swellings, are not observed, the excretions which may assist us in discriminating are likely to be mixed with blood. Postmortem examination will usually decide the question, especially the altered appearance of the blood and the enlarged spleen, while the detection of the anthrax bacillus in the blood would be final.

In rabies there is usually the history of an animal having been bitten, followed by the appearance of characteristic symptoms after a more or less definite period of incubation. On autopsy, the absence of macroscopic alterations would exclude the disease under consideration, while subdural inoculations of susceptible animals could be made in case a discrimination should otherwise be impossible.

In hemorrhagic septicemia, or game and cattle disease, the symptoms of edematous swellings of the throat, shoulders, and joints, associated with the exanthematous form of the disease, would be diagnostic. In the intestinal and pectoral forms the main differential feature is the acute course of the disease, usually terminating in 24 hours; the temperature is usually excessive (107° F.) and is accompanied by bloody discharges from the rectum and bladder. The postmortem examination shows more lesions to account for the death of the animal than the cattle disease under consideration, the most prominent of which are hemorrhagic extravasations into the subcutaneous, subserous, submucous, and muscular tissues, the lymph glands and the viscera, while in the latter disease petechial hemorrhages were usually confined to the endocardium, the abomasom, and the anterior portion of the small intestines. Finally, the isolation of a small nonmotile, nongas-producing bacterium belonging to the hemorrhagic septicemia group will definitely fix the diagnosis.

The differential diagnosis from mycotic enteritis will be found very difficult from the symptoms alone. There is usually an intense fever, the animal is bloated, and the feces may be mixed with blood. The autopsy generally shows the mucous membrane of the stomach and small intestines to be diffusely injected and swollen. If the disease has run a longer course, intestinal perforation, gangrenous areas, or peritonitis may be observed. A bacteriological examination or inoculation tests will be required to differentiate this disease.

In gastroenteritis, due to mineral poisons and the like, reliance would have to be placed on the history and the sudden appearance of the symptoms of abdominal pain, absence of fever, and especially on postmortem examination and chemical tests. If the cattle disease in question was suspected and no opportunity presented itself for making an autopsy, it is probable that a diagnosis could be made by inoculating susceptible animals—preferably rabbits—with the blood obtained from the ear of an affected animal.

TREATMENT.

It is a rather discouraging realization for an owner of live stock to find that after obtaining an accurate knowledge of a disease affecting his animals there is very little in the way of medicinal treatment which will be of any avail, but such is frequently the case in infectious diseases, and especially in those whose manner of action is that of a virulent poison coupled with the presence of myriads of microbes scattered throughout the system, interfering particularly with the proper performance of the functions of the cells of those organs the sum total of whose normal energies are embodied in the phenomena of life and health. Being confronted with such a condition of circumstances, one turns of necessity, but quite naturally, to what is evidently of greater importance, namely, to check the spread of the disease to his other stock or to that of his neighbors, by the adoption of prophylactic rather than curative measures.

Prophylaxis.—Segregation of the affected animals is to be recommended and the quarantine observed for at least 6 weeks after the last evidence of the disease is noted. The carcasses of animals having died from the disease should be totally destroyed, preferably by cremation, otherwise by burying in a hole 6 feet deep and covering them with lime. The stalls and barns should be carefully disinfected by the application of a 1 to 1,000 corrosive sublimate solution or 5 per cent carbolic acid in the form of a wash.

In the way of sanitation the water supply should be especially looked after, as it is known that many pathogenic germs not only exist for a long time, but may multiply therein. This is probably the usual source of infection, and it is therefore necessary to guard the water supply from contamination by surface drainage; also to prevent cattle from having access to watering troughs used by swine or from pools of water contaminated by drainage from pigpens. They should be pastured, if possible, on high ground, where there are no stagnant pools. The principal idea to be kept in mind is that the disease is highly contagious and may have a lengthy period of duration, which facts should emphasize the importance of keeping the premises not only under constant sanitary conditions, but, in the event of such an infection, to get rid of it in the quickest and most thorough manner possible.

Curative treatment.—The administration of medicinal treatment in infectious diseases is usually fraught with danger and frequently does more harm than good. In some mild attacks of the disease, or where the animal is unusually strong and vigorous, great benefit may be derived from a judicious attempt to relieve the symptoms and thus assist nature in overcoming the disease. Thomassen has used various remedies in the above-described septicemia in calves. The hypodermic injection of 10 c. c. of a 2 per cent solution of car-

bolic acid or 5 c. c. of a 10 per cent solution of eucalyptol in olive oil, also drenching with spirits of camphor and various preparations of iodine, have given questionable results. The following, however, has been found efficacious in his hands: Carbolic acid, 1 c. c.; alcohol, 30 c. c.; limewater, 300 c. c.; oil of peppermint, 3 c. c. This should be repeated three times a day. He also recommends rectal douches of a 2 per cent solution of creolin in cases complicated with diarrhea.

The above treatment was unknown to the writers at the time when it could be administered in this outbreak, and, as the nature of the latter was not definitely ascertained, symptomatic therapy was indicated and administered. This treatment was used upon the last 7 cases that became affected, the first animal having died before we were called in and the disease in the next 3 cows being too far advanced to expect any results. Castor oil in 2-pint doses, to which 2 c. c. of croton oil had been added, was given as a drench, followed by the hypodermic injection three times daily of the following: Hydrobromate of hyoscin 0.01 gm., sulphate of atropin 0.05 gm., tincture of digitalis 10 c. c.

The value of these remedies has not been sufficiently demonstrated, and it would be unwise to place undue importance upon the beneficial action of the above treatment in such a limited outbreak; but, nevertheless, the result showed that but 4 cows died after receiving this treatment, 1 of which ran a chronic course, while the remaining 3 of the 7 affected animals completely recovered and are apparently in good health at the present writing.

CONCLUSIONS.

The following conclusions, which are the outcome of this investigation, seem justifiable:

1. That a spontaneous enzootic among cattle resulted from a bacillus of the enteritidis group.
2. That this organism was isolated from the cattle in pure culture.
3. That when inoculated into susceptible experimental animals a similar disease was reproduced, from which the specific bacillus was recovered.
4. That it is pathogenic for rats, guinea pigs, rabbits, pigeons, dogs, sheep, hogs, and calves, but is not infectious for chickens.
5. That the organism isolated from this outbreak is more virulent than that usually obtained from hogs affected with hog cholera, and is pathogenic for a greater number of species.
6. That a closely allied disease has been previously described by Thomassen as occurring in enzootic form among bovines, and bacilli very similar to the one under consideration have also been isolated from the viscera and muscle juice of individual cattle and from beef which produced symptoms of poisoning in the consumers.

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BOVINE TUBERCULOSIS AND OTHER ANIMAL DISEASES AFFECTING THE PUBLIC HEALTH.[a]

By D. E. SALMON, D. V. M.,
Chief of Bureau of Animal Industry.

Your committee on animal diseases and animal food respectfully report as follows with reference to subjects which have received their attention during the time that has elapsed since the last meeting of the association:

TUBERCULOSIS.

The last report which this committee had the honor to submit discussed the important question of the relation of bovine tuberculosis to the public health, reviewed the data available at that time, and concluded that the weight of evidence was overwhelmingly against the assertion of Koch that cattle are insusceptible to human tuberculosis and that man is insusceptible to bovine tuberculosis. As anticipated in that report, numerous investigators at once instituted researches, and the results of the experiments are now being made public. Your committee feel that the question is of such general interest, and, indeed, that its elucidation is so essential to the proper performance of the duty of the sanitarian, that they venture to review it again in the light of the most recent information attainable. There are some apparent inaccuracies in the paper which Koch read before the British Congress on Tuberculosis, to which your attention is invited. He says:

> Even in my first circumstantial publication on the etiology of tuberculosis I expressed myself regarding the identity of human tuberculosis and bovine tuberculosis with reserve. [1] [b]

A reference to the paper which Koch mentions will show that he expressed himself as follows:

> It is not the peculiar structure of the tubercle, not its lack of blood vessels, not the presence of giant cells that will give the solution, but rather the proof of the tuberculosis bacilli, whether it be in the tissue by means of staining reaction or whether it be by means of culture upon coagulated blood serum. This criterion being adopted as a foundation principle, according to my investigations, miliary tuberculosis, caseous pneumonia, caseous bronchitis, intestinal and glandular tuberculosis, bovine tuberculosis, spontaneous and inoculation tuberculosis of animals must be declared as identical.

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[a] Report of committee on animal diseases and animal food to American Public Health Association at New Orleans, La., December 8–12, 1902.

[b] References are to bibliography at end of article.

Again he says:

The tuberculosis of domesticated animals, especially bovine tuberculosis, undoubtedly forms another source of infection with tuberculosis. By this is also characterized the position which the care of health is to occupy in the future in consideration of the harmfulness of the meat and of the milk of animals suffering with bovine tuberculosis. Bovine tuberculosis is identical with human tuberculosis, and therefore a disease transmissible to man. It is therefore to be treated just like other infectious diseases transmissible from animals to human beings. However great or small may be the danger which results from the consumption of meat or milk affected with bovine tuberculosis, it is present and must therefore be avoided. It is sufficiently well known that meat affected with anthrax is eaten by many persons and often for long periods of time without harm, and yet no one will draw the conclusion from this that the traffic in such meat is to be permitted.[2]

It is hardly necessary to add that the question appears to have been treated, in the paper mentioned, without any reservations whatever, and that the statements of the identity of human and bovine tuberculosis were emphatic and unequivocal. Of course, it is allowable for an author to change his views with the discovery of additional facts, but he may not cite his earlier paper in support of the later contention when the language of the earlier paper gives, as in this case, an opposite impression.

Again, with reference to the results of the earlier investigators of the subject, he states:

If one studies the older literature of the subject, and collates the reports of the numerous experiments that were made in former times by Chauveau, Guenther and Harms, Bollinger, and others, who fed calves, swine, and goats with tubercular material, one finds that the animals that were fed with the milk and pieces of the lungs of tubercular cattle always fell ill of tuberculosis, whereas those that received human material with their food did not.[1]

In your committee's last report [3] quotations were made from Chauveau's paper showing clearly that in his experiments cattle were successfully infected with human tuberculous material by ingestion, by intravenous injection, and by subcutaneous inoculation. From all of these experiments he concluded that the human tubercular virus acts on the bovine species exactly like the tubercular virus which comes from the bovine species itself.[4]

Bollinger [5] in 1879 and Sidney Martin [6] in 1895 also obtained successful results with bovine animals, one by inoculation into the peritoneal cavity, the other by feeding sputum. Your committee have not been able to consult the papers of Guenther and Harms, which were also cited by Koch, but whatever their results may have been it is sufficiently demonstrated that the older investigators were not unanimous in finding that "the animals that were fed with the milk and pieces of the lungs of tubercular cattle always fell ill of tuberculosis, whereas those that received human material with their food did not." What is most striking in a review of these earlier investigations is the variability of the results. Chauveau found human as

virulent as bovine material for bovine animals. Martin found human sputum much less virulent than bovine material, while others failed entirely in the effort to infect bovine animals with human tuberculous material.

It would seem that the cause of this lack of harmony in the results of experiments of the same character should have been suggested by the researches of Vagedes,[7] who, in 1896, studying 28 human cultures, discovered one of these which was much more virulent than the others, and which was more virulent than either of two bovine cultures used in the investigation.

Theobald Smith says in regard to this work:

It is somewhat remarkable that this exceptional culture of Vagedes, described in a work done under the direction of Koch himself, was wholly ignored by the latter.[8]

Lartigau[9] in 1901 published results from which he concluded that tubercle bacilli of widely different virulence may exist in different cases of human tuberculosis. One culture obtained by him was extremely virulent for guinea pigs and rabbits, and had morphological and cultural peculiarities which closely suggested the bacillus tuberculosis of bovine derivation as described by Smith.

Koch[1] says of his experiments:

In some cases the tubercle bacilli or the sputum were injected under the skin, in others into the peritoneal cavity, in still others into the jugular vein. Six animals were fed with tubercular sputum almost daily for 7 or 8 months; four repeatedly inhaled great quantities of bacilli, which were distributed in water and scattered with it in the form of spray. None of these cattle (there were 19 of them) showed any symptoms of disease, and they gained considerably in weight.

For the discrimination between human and bovine bacilli he recommends the subcutaneous inoculation of bovine animals. Investigators who have since endeavored to elucidate the subject have therefore endeavored to infect animals with human material by any one or more of these methods which failed in the hands of Koch and his assistants. It is very interesting to study their results.

RECENT RESEARCHES WITH REFERENCE TO THE COMMUNICABILITY OF HUMAN TUBERCULOSIS TO ANIMALS.

Ravenel[10], of the Pennsylvania live stock sanitary board, and a member of this committee, in 1898 fed 4 calves with human sputum. Postmortem examination proved that all had become affected with tuberculosis, the lesions in 2 being quite extensive. In March, 1901, he obtained material from the mesenteric glands of a child which died of tubercular meningitis. The bacilli from this material have proved very virulent for bovine animals. One calf inoculated intravenously with a suspension of a culture of this bacillus showed marked illness during life and died in 17 days. Both lungs were

found thickly studded throughout with miliary nodules. The bronchial and mediastinal glands were much enlarged and soft, the former showing small areas of caseation. The liver was soft and friable, and several nodules were visible on its surface.

A second calf was inoculated into the peritoneal cavity with a similar suspension of a culture of this bacillus. This animal died in 27 days, after showing an abnormally high temperature from the eighth day. It was greatly emaciated, having lost 37 pounds in weight. The central and posterior portions of the lungs showed many areas deep in color and solid to the feel. These were thickly studded throughout with minute grayish nodules. The suprasternal lymph glands were as large as goose eggs, and contained cheesy areas. The mediastinal glands were much enlarged. The peritoneum was everywhere enormously thickened and practically converted into a tuberculous mass. The omentum and liver contained many nodules.

A cow was inoculated intravenously with only 2½ c. c. of a suspension of a similar culture and died in 17 days. The lungs were thickly studded throughout with miliary nodules.

A second culture obtained from the mesenteric glands of a child, and which in its manner of growing and microscopical appearance led the investigator to consider it a typical human culture, was found to be unexpectedly virulent when tested upon dogs. A calf inoculated intravenously with suspension of a culture was killed on the forty-sixth day, death then appearing imminent. The anterior lobes of both lungs were thickly studded with minute nodules averaging 1 mm. in diameter. The bronchial and mediastinal glands were enlarged, and scrapings from the cut surfaces showed an enormous number of tubercle bacilli. Many yellow nodules were seen in the mediastinal glands. In the liver were many minute nodules, sections of which showed large numbers of tubercle bacilli. The spleen showed round-cell infiltration, giant cells, and many tubercle bacilli. There were also white areas in the kidneys with round-cell infiltration and many bacilli.

In the Bureau of Animal Industry a number of virulent cultures of tubercle bacilli have been obtained from human sources. A few of these are worthy of notice in this connection. De Schweinitz [11], of the Biochemic Division, isolated a tubercle bacillus from a mesenteric gland of a child affected with tubercular peritonitis. This bacillus, when grown on egg medium, corresponded to the bovine type. A calf received intravenously 5½ c. c. of a suspension made from an egg culture. This animal died in 20 days of generalized tuberculosis. The lungs were a mass of small tubercles, while the bacilli were demonstrated in the liver, spleen, kidneys, and mesenteric and mediastinal glands. The same investigator obtained a culture from another child affected with peritoneal tuberculosis. This culture also corre-

sponded to the bovine type when grown on egg medium. A calf inoculated intravenously with 5 c. c. of a suspension of egg culture died in 17 days. The autopsy showed generalized tuberculosis, numerous bacilli being demonstrated in the lung, liver, spleen, and mediastinal glands. A steer was inoculated subcutaneously with a piece of tuberculous tissue from this child. The animal was killed at the end of 6 months, and the autopsy showed the flank and shoulder glands enlarged, caseous, and calcified. There were numerous excrescences upon the border of the lung and upon the pleural surface of the diaphragm. Bacilli were demonstrated in these excrescences and also in the glands. Both of these cultures are therefore very virulent for bovine animals when given by intravenous inoculation, and one at least is virulent when injected subcutaneously.

A calf previously tested with tuberculin, as was done with all the larger animals used in these experiments, was inoculated subcutaneously in the side of the neck with 5 c. c. of a suspension of a culture of this bacillus. This animal presented the ordinary signs of tubercular infection, and, being emaciated, weak, unable to rise, and in a dying condition, was killed on the thirty-first day. The autopsy showed generalized tuberculosis. The prescapular gland and mediastinal glands were enlarged and tubercular, the lungs were filled with tubercular nodules, and the liver was affected to an almost equal extent. The omentum showed many tubercular nodules and the kidneys a small number.

Mohler[11], of the Pathological Division, has obtained three cultures of bacilli from human sources which, because of their virulence for the species of animals on which they have been tested, are also worthy of mention. One of these, which had its source in the mesenteric gland of a girl that died of tuberculosis, appears more virulent for goats and cats than the first culture of Ravenel's above mentioned. A goat inoculated subcutaneously was in poor condition and growing thinner at the end of 137 days. A cat inoculated in the same manner died in 104 days of pulmonary tuberculosis. A rabbit was in poor condition at the end of 137 days. The bacilli cultivated in dog serum averaged 2 μ in length, some slightly curved and beaded. This bacillus was of the human type, but when recovered from the cat it was markedly reduced in length and slower in growth.

Another bacillus obtained from the mesenteric gland of a boy affected with tuberculosis is shorter, averaging from 1.2 to 1.5 μ, is beaded, and grows rapidly and luxuriantly. A goat inoculated subcutaneously with this culture died in 37 days with miliary tuberculosis of the lungs, involving the axiliary and prescapular glands. A dog inoculated in the same manner, after 59 days was thin and becoming emaciated, and had an ulcer at the point of inoculation. A cat similarly inoculated was in poor condition at the end of 59 days. The third germ, obtained by Mohler, is particularly worthy of

attention, because it was isolated from human sputum. It is, when grown on dog serum, 1.7 to 2.2 μ in length, slender, beaded, and curved. A goat inoculated subcutaneously died in 95 days of pulmonary tuberculosis. There were also tubercular lesions at the point of inoculation and in the prescapular gland. A cat inoculated subcutaneously died in 23 days of generalized tuberculosis. A rabbit inoculated in the same manner died in 59 days of pulmonary tuberculosis. A bovine culture was used for comparison with the cultures just described and killed a goat in 55 days, as compared with 37 days for the second human culture and 95 days for the third human culture. The bovine germ also killed a rabbit in 69 days as compared with 59 days for the third human culture. This work also shows that it is not a difficult matter to obtain very virulent tubercle bacilli from human sources, and that some of these are just as virulent as bovine bacilli.

At the British Congress on Tuberculosis, Thomassen [12] reported an experiment in which a calf was inoculated in the anterior chamber of the eye with a pure culture of a tubercle bacillus isolated from a case of tuberculous arthritis in man. When killed, after six weeks, it was found that both lungs contained numerous miliary tubercles and some gray fibrous tubercles of larger size. The path of infection from the eye to the lung could be traced by the condition of the subparotideal, cervical, mediastinal, and bronchial lymph glands of the same side.

De Jong [13] reports, as a result of a series of inoculations, that 7 bovine animals, namely, 2 calves six months old, 3 steers two years old, 1 eighteen months, and 1 calf seven or eight months old, all became tuberculous by the injection of tubercle bacilli of human origin. Consequently all the bovine animals used in the experiment were infected by human bacilli. The disease produced was serious and very extended in only 1 animal, with 4 others it had a retrogressive tendency, and in the two remaining cases it was progressive. He concludes that these results demonstrated that bacilli isolated from the human body or from sputum are capable of causing tuberculosis of cattle.

Delépine [14] recently stated, in a discussion on the relationship of human and bovine tuberculosis, that he had been able to obtain from the human subject bacilli just as virulent as the bovine tubercle bacillus, but in most the human tubercle bacillus was less virulent.

Orth [15] made experiments with 3 calves, 3 swine, and 3 goats. The infectious material was obtained from a case of phthisis cavernosus by inoculating a guinea pig and then obtaining cultures from this animal from brain and other media. In the experiments bouillon cultures of the organism were used, and in some cases tuberculous organs from rabbits. One calf inoculated into the lung through the trachea gave an entirely negative result. The second, inoculated

between the abdominal muscles, showed only a local caseous abscess. The third, which was inoculated in the peritoneal cavity with two pieces of tuberculous kidney from a rabbit, died on the twenty-sixth day of a general tuberculous peritonitis. The serous membranes were covered with miliary and submiliary tubercles. The great omentum had nodules scattered throughout and small nodules were visible on the serous membrane of the intestine. The mesenteric portal and retrosternal lymph glands were much enlarged and showed gray and white nodules upon section. There was no doubt but that a progressive fatal tuberculosis was produced in this calf by material originating in the human subject.

Of the 3 pigs, 2, which were inoculated intraperitoneally with the bouillon culture, gave negative results. The third, inoculated through the trachea into the lungs, was killed after five and one-half months and a large number of miliary and submiliary tubercles were found in the inferior lobe of the right lung, and there were many yellowish tuberculous nodules in the thymous gland and in the membranes around it. One of the goats inoculated through the trachea into the lung with the bouillon culture showed a number of subcutaneous nodules near the point of inoculation, a large caseous nodule in the thymous gland, and a number of yellowish gray nodules in the inferior lobe of the right and left lung. The second goat was inoculated intraperitoneally with a small piece of lung from a tuberculous rabbit. The animal was killed after five months and a number of nodules were found in the muscles and subcutaneous tissue at the point of inoculation. There were also a number of small, grayish translucent nodules scattered through the omentum, on the diaphragm, and in the neighborhood of the lymph glands; a nodule about the size of a pea was found on the anterior border of the liver. The third goat was inoculated with a piece of tuberculous spleen the size of a pea placed in the peritoneal cavity. On autopsy a number of tubercles were found around the point of inoculation. There was a large group of caseous nodules on the adjoining surface of the stomach and numerous caseous nodules in the omentum, many of these latter having small pedicles. Tubercle bacilli were easily demonstrated, and there was no doubt as to the tuberculous character of the lesions nor that they were produced by human tubercle bacilli.

Stenström [16] inoculated 8 calves in various ways with tuberculous sputum rich in tubercle bacilli. Of these the following showed positive results: No. 224 was inoculated in traperitoneally with 5 c. c. sputum. When killed, after six months, the autopsy showed many calcified nodules upon the omentum and an enlargement of the glands connected therewith. Many miliary tubercular foci were present in the liver, and the posterior lobe of the right lung showed hypertrophy of the connective tissue on its serous cover. No. 820 was inoculated in the lungs with 20 c. c. When killed, after four months, it showed many

tubercular growths on the costal and diaphragmatic pleura, and tubercular nodules in two mediastinal glands. No. 883 was inoculated intratracheally on October 8 with 6 c. c. and on November 8 with 10 c. c. of sputum; was killed March 17 and showed partially calcified nodules in the posterior and anterior mediastinal glands and also in the bronchial glands. Stenström disagrees with Koch and states that he found it quite easy in his experiments to infect cattle with human tuberculosis.

Fibiger and Jensen[17] attempted to answer the question as to the intercommunicability of human and bovine tuberculosis by selecting from the various hospitals of Copenhagen those cases of tuberculosis in which the autopsy indicated a primary intestinal infection. They report in all five cases of tuberculosis in the following subjects: (1) A 42-year-old woman, (2) a 11-year-old girl, (3) a 6-year-old boy, (4) a 19-months-old girl and (5) a 4-months-old boy. A 3-months-old calf was inoculated in the thoracic cavity with a suspension made from a mesenteric gland of case No. 1. This calf remained apparently in good condition and was killed at the end of six months. Two miliary tubercles and a few fresh pearl nodules were found on the pleura. A 3-months-old calf was inoculated with a suspension made from the spleen of a guinea pig which had been inoculated with a mesenteric gland from case No. 2. When killed, at the end of the fifth month, there were found a large number of small red growths and about twenty small fresh pearl nodules on the omentum. On the diaphragm there were some small nodules and excrescences and one small excrescence on the pulmonary pleura. A calf was inoculated intraperitoneally with a suspension made from the spleen of a guinea pig which had been inoculated from case No. 3. When killed, after about five months, the omentum was found filled with tuberculous growths and showed countless small nodules of varying size. There were some small nodules found on other portions of the peritoneum and the surface of the spleen, liver, and diaphragm was covered with small pearl nodules. A calf was inoculated subcutaneously on the right side of the neck with a suspension made from a mesenteric gland of case No. 4. When killed, at the end of the third month, there was a large caseous mass at the point of inoculation; the neighboring glands were large, caseous, and calcified; the lungs had scattered through them many small miliary nodules, and there were a number of excrescences attached to the pulmonary pleura. The bronchial and posterior mediastinal glands were enlarged, hard, and contained fresh, caseous, and calcified nodules. On the surface of the liver there were ten small pearl nodules. Miliary tubercles were scattered through the liver and spleen, and the omentum was filled with fine, diffused, red new growths.

Two 10-days-old calves were inoculated subcutaneously on the side of the neck with a suspension made from a mesenteric gland from case No. 5 Both of these animals died within three weeks from

secondary infection. Nevertheless, there developed a considerable local tuberculosis rich in bacilli. From calf No. 2 a third calf was inoculated subcutaneously on the right side of the neck. A large abscess formed at the point of injection, and the calf, being in a dying condition, was killed at the end of about two months. The autopsy showed, in addition to the local lesions, tuberculosis of the adjacent lymph glands, with many new growths on the costal and diaphragmatic pleura, and a few on the pulmonary pleura. The lungs contained a countless number of small nodules, in some portions so close together that the air was practically absent. The bronchial and mediastinal glands were enlarged and caseous; the liver, spleen, and kidneys had miliary tubercles scattered through them. The intestinal wall was very rich in fresh nodules and small superficial ulcerations. The mesenteric glands were enlarged and tuberculous. The omentum was rich in small new growths. A cow about ten years old was inoculated on the left side of the neck with material from calf No. 1, and developed an abscess at the point of inoculation. When killed, at the end of four months, in addition to the local abscess, the neighboring glands were enlarged, caseous, and calcified. Miliary tubercles were scattered through the lungs, a nodule the size of a pea was found in the posterior mediastinal gland, and a small number of miliary tubercles in the liver. The authors say that it is thus seen that in the three cases of tuberculosis in children the bacilli present were virulent, some of them in the highest degree for calves, and it is probable that the disease in children was caused by bacilli which came from cattle. In the five cases there were found bacilli having the greatest variation in virulence for calves, from those which were entirely avirulent to those which were slightly virulent, virulent, and of the highest virulence. They conclude by stating that Koch announced that one could distinguish between human and bovine tuberculosis by inoculating calves subcutaneously. If this is true, then they are of the opinion that three of the cases just cited must be considered as "Perlsucht," and the idea that tuberculosis of cattle is not virulent for men is disproved.

Max Wolff[18] reports inoculations from a case of primary tuberculosis of the intestines in man which he considers fully meets all the requirements demanded by Koch for the experimental solution of this uncommonly important question. Two guinea pigs were inoculated with diseased spleen. Seven or eight weeks afterwards they gave unmistakable evidence of being tuberculous and were in consequence killed. In each animal both lungs were studded with nodules of the size of a pin head, the liver contained numerous submiliary nodules, and a swollen, cheesy gland was located at the hylus of this organ. The spleen was studded with nodules, many of them exceeding the size of a pin head. A calf was inoculated in the side of the neck with 12 c. c. of sterilized water in which bits of a lung and spleen from the guinea pig had been macerated. Microscopic examination of this

material showed tubercle bacilli to be present in very scanty numbers. Eighty-three days after inoculation the calf was killed. It had become considerably emaciated. The autopsy revealed very severe changes at the point of inoculation and characteristic pearl disease in the internal organs. Upon the surface of the pleura were numerous pedunculated tumors ranging in size from a flaxseed to a cherry, and between these were hyaline miliary tubercles. The lungs showed many grayish tubercles, and the pericardium was covered with them. The mesentery contained countless small tumors, many of them pedunculated. The capsule of the spleen was studded, and the liver showed numerous miliary tubercles in its pulp and on its capsule. Each kidney bore five or six grayish tubercles the size of flaxseed upon its outer surface. The virulence of the germs isolated from this calf was further proven by inoculations upon the guinea pig. The author thinks that it is here proven that pearl disease of cattle may appear in man.

Nocard [19] states that cattle are not refractory to human tuberculosis and that it is easy to give the proof of this. If they are inoculated in the arachnoid cavity with a few drops of a feeble culture of the human bacillus they succumb in less than a month, and the autopsy reveals lesions of tuberculous meningitis absolutely identical to those of children. A calf five months old, inoculated in this way August 2, succumbed August 28. A portion of its pia mater, infiltrated with tubercles, killed in six weeks the guinea pig which received it in the peritoneum.

Arloing [20] reports experiments with three different cultures of human origin. One of these had been in his laboratory since 1896. It was capable of infecting guinea pigs and rabbits by subcutaneous inoculation. He inoculated by intravenous injection with an emulsion of this culture a heifer, a young calf, 2 sheep, and a kid. On autopsy he says that the calf and the sheep presented a superb eruption of tuberculous granulations in all parts of the lung, principally in the anterior lobe. With the kid the lesions were more diffuse and so extensive that the lungs scarcely collapsed when removed from the thorax. The heifer showed signs of pleural disease, for very marked excrescences were found on the borders of the lung and on their diaphragmatic surface. A small number of tubercles were found scattered through the lung. With the second culture he inoculated intravenously a calf, 2 sheep, and a goat. The autopsy demonstrated the existence of tuberculosis of the lungs in all of these animals. With the calf there were found a multitude of small young tubercles, and the subpleural granulations slightly raised in the serous membrane were easily seen. With the sheep the lungs had but little tendency to collapse. There were many subpleural granulations and small tubercles throughout the parenchyma. With the goat the lesions recalled those found with the sheep, but were less confluent.

With an emulsion of the third culture he inoculated a young bull, 2 sheep, and a goat, by intravenous injection. The bull died at the end of 32 days. It was considerably emaciated, having lost 35 kilograms. The anterior and median lobes of the two lungs were studded with tubercles of various sizes, the largest being the size of a millet seed. The bronchial and esophageal glands were enormous, weighing 400 grams. In the lungs of the sheep there were perceived by the touch an enormous number of small subpleural tubercles. On section there were also seen many tuberculous granulations in the depth of the parenchyma. With the goat the lesions were similar to those found in the sheep, except the granulations were smaller.

Behring[21] reports an experiment in which human sputum was injected into a guinea pig and a culture from this animal's spleen was used for inoculating a goat. An emulsion of the spleen of the goat was passed through a series of guinea pigs, and a culture obtained from the spleen of the third guinea pig was inoculated into a calf by intravenous injection. The calf died after four weeks, directly from the tuberculosis thus produced. At the autopsy the lungs were found in the red stage of hepatization. From these organs tubercle bacilli were recovered in large numbers. A fairly numerous collection of subpleural nodules were present, which were yellowish in color and had reached in some instances the size of peas. Tubercle bacilli were recovered readily from these nodules. The bronchial glands were swollen and tubercle bacilli were proven present within them. The liver contained fatty infiltrations, and the spleen was darkened, but scarcely enlarged. Tubercle bacilli were recovered from it, but were not numerous. The pronounced malignity of the virus in this instance is worthy of particular notice, because it concerns bacilli derived from human sputum, although they had been passed through the goat. A cow was also inoculated with a tuberculosis culture of human origin after a single passage through a guinea pig. The inoculation was made intraocularly on November 26, 1901. On January 14, 1902, the affected eye was enucleated and a pure culture was obtained from it after one passage through a guinea pig. The cow did not die at once as a result of the inoculation, but has been gradually losing ground and was, at the time the report was made, in a condition of chronic disease so serious that the final outcome could not be foretold.

Dean and Todd,[22] who have recently carried out certain experiments to ascertain whether the tubercle bacillus of human origin undergoes any marked change in virulence for the bovine species by passage through certain other animals, say that "the experiments show that the human tubercle bacillus is by no means innocuous to the calf, as the control animal injected directly with sputum contracted an extensive glandular tuberculosis;" also, "as mentioned above, with reference to the infection of the pig, an important result

was obtained, as the experiments conclusively prove that this animal is capable of contracting a rapidly fatal general tuberculosis as the result of inoculation with the tubercle bacillus of human origin."

These investigations are now sufficiently numerous and sufficiently harmonious in their results to establish the following conclusions:

1. The bacillus tuberculosis found in human tuberculosis differs greatly in its pathogenic powers as obtained from different cases.

2. Two types of tubercle bacilli may be obtained from man, namely, one which is somewhat difficult to cultivate, which grows slowly, and the bacilli of which are short, stubby, and free from beading—the so-called bovine type; and a second, which is quite easily cultivated, grows rapidly, is longer, thinner, and inclined to show beaded and curved forms—the so-called human type.

3. Virulent cultures may be obtained from both of these types, which, when inoculated according to the methods used by Koch and upon the species of animals specified by him, produce progressive and fatal tuberculosis.

4. The contention that human tuberculosis can not be transmitted to asses, sheep, goats, swine, and especially to cattle, has been completely disproved.

5. Koch's failure to produce tuberculosis in the animals named with bacilli from human sources was probably due to the use of bacilli of low pathogenic power.

THE TRANSMISSION OF BOVINE TUBERCULOSIS TO MAN.

Some interesting observations have also been made during the year with reference to the transmission of bovine tuberculosis to man. Krause reports the case of a laborer who was brought to the clinic in order to ascertain whether the trouble in his right arm was due to infection, and, if so, of how long standing. The man stated that he was a butcher whose duty it was to remove the diseased parts of cattle killed for food. Three years previously he ran a splinter of wood from a table into his right thumb, and immediately afterwards removed the hide from a sick cow. Soon his arm swelled and pained him; later it was covered with discharging ulcers of various sizes. Incisions were made in the arm, but without causing complete healing; afterwards larger incisions were made, which were successful. Pieces of gland and skin from the arm proved on examination to be tuberculous. According to the man's statement, he is of a healthy family, 30 years old, and had not previously suffered from disease. The lungs were sound, as were all the other internal organs, and his mind was clear. The reporter thinks there is no doubt whatever that this was a case of inoculation tuberculosis traceable directly to the splinter wound on the thumb.

Ravenel[23] reported, in his address at the British Congress on Tuberculosis, the case of his assistant, who was inoculated with bovine

tuberculosis, and from whose tissues bacilli were recovered after 58 days which retained the activity of the original bovine virus.

Quite recently Spronck and Hoefnagel[24] recorded the following case: In May, 1900, a veterinarian accidentally wounded with a knife the finger of a butcher who was assisting him in inspecting the tuberculous organs of a cow. The wound healed promptly, but was followed in a few days by tumefaction and the formation of cracks in the skin. The skin of the finger became thickened and blue in color and the cracks covered with little scabs. In February, Professor Nareth extirpated the affected portion of the skin, together with the tumefied cubital ganglia. The tuberculous nature of the cutaneous lesions, as well as that of the hypertrophied ganglia, was easily recognized both by microscopic examination and by the inoculation of guinea pigs. A calf previously tested with tuberculin was placed in a newly constructed stable, in which no animal had been kept, and inoculated with an emulsion made from the spleen of one of these guinea pigs. Five days after the inoculation a swelling was noticed, and in a few days the superficial cervical ganglia were visibly tumefied. The animal soon exhibited constitutional symptoms, remained lying down most of the time, and drank excessively. The swelling increased rapidly and the animal was slaughtered 57 days after the inoculation. At the autopsy there was found at the point of inoculation on the right side of the neck a tuberculous granuloma the size of a fist inclosing at its center a large cavity filled with a soft, cheesy mass. The neighboring superficial ganglia were found granulomatous, hypertrophied, and hard. The pleura and the visceral folds presented numerous tubercles, varying in diameter from 1 to 6 mm. The tissue of the lungs was also the seat of numerous tubercles of similar size, each showing an inflammatory areola. The bronchial and mediastinal glands were hypertrophied, and on section showed caseous, noncalcified contents. Similar conditions were found in the organs generally throughout the body. Microscopic examination demonstrated that the tuberculous foci contained abundant giant cells and numerous tubercle bacilli. Finally, 2 guinea pigs which had been inoculated with material from the hypertrophied cervical ganglia—1 in the peritoneum and the other beneath the skin—died of tuberculosis. The bacilli had consequently retained their virulence for a period of twenty months, during which they lived in human tissues. These observations, according to the authors, leave no doubt as to the possibility of the infection of man with bovine tuberculosis, and they hold that cases of contagion from the use of milk, butter, and meat of tuberculous cattle are not so rare as Koch and Baumgarten maintain.

Lassar[25] was impelled by Koch's statements to examine closely the records of his patients during the past decade to determine how many of those that were suffering from verrucose tuberculosis of the

skin of the hands could have been infected by means of injuries received in handling tuberculous meats. He found 34 cases of tuberculosis following wounds in 108,000 patients, but only 4 of this number were butchers. He later questioned and examined 365 men who were employed in abattoirs, and found 7 suffering from inoculated tuberculosis, while 3 others must be considered as possibly affected. This shows 2 to 3 cases to each 100 men employed in the abattoirs, and only one-third of 1 per 1,000 among persons otherwise employed.

Hüls [26] reports a case of a miller's family in good circumstances near Manderschied, composed of the miller, his wife, five sons, and two daughters, all herculean in stature and boastful of strength and health. Consumption had never occurred in the families of either of the parents. The mother became affected with pulmonary catarrh, which aroused a suspicion of tuberculosis, but after a few months she was again healthy. During the following year the 13-year-old daughter became ill of pulmonary tuberculosis and died. The same year an 18-year-old son died, and the following year a 23-year-old son. Two years after her first illness the mother sickened and died; then followed the death of a 16-year-old daughter, then the father, and finally the third son, all of pulmonary tuberculosis. For one of the two remaining sons a tuberculous abscess of the finger was treated, which healed. These two men are still living. Hüls thinks that the view of contagion from the sick members of the family can not be held, since there was practically no contact. These cases appeared subsequently to the introduction by the miller of a herd of Simmenthal cattle on his farm. These cattle were all practically infected with tuberculosis, and it was scarcely possible to dispose of the meat on account of its infected condition. Many of the carcasses were returned on account of being tuberculous, so that later he was compelled to sell the cattle without a guaranty as to their condition.

Considering these facts, in connection with those of similar bearing previously reported, it may be said that the transmission of bovine tuberculosis to man is fairly well established. The apparent inoculation of a human subject with bovine tubercular material, the development of a tubercular process at the point of inoculation, the isolation from the human tissues months afterwards of a tubercle bacillus having the characteristics of the bovine bacillus, constitute a chain of evidence that is conclusive.

INVESTIGATIONS BEARING UPON INTESTINAL INFECTION.

Heller [27] has made an investigation as to the comparative frequency of primary intestinal tuberculosis. He says that it is well known that tuberculosis frequently appears after diphtheria, and he therefore investigated to determine first how often tuberculosis was present before the attack of diphtheria, and, second, how often the primary lesions were located in the intestine.

Sections were made from 714 victims of diphtheria, and among these 140, or 19.6 per cent, were found to have an associated affection of tuberculosis in various organs.

2, or	1.43	per cent, showed primary intestinal tuberculosis.
8, or	5.7	per cent, showed primary intestinal and mesenteric gland tuberculosis.
33, or	23.5	per cent, showed primary mesenteric gland tuberculosis.
43, or	30.7	per cent, of all the tuberculosis cases.
43, or	6	per cent, of all the diphtheria cases.
10, or	7.1	per cent, had mesenteric gland tuberculosis, with affection of other abdominal organs.
53, or	37.8	per cent, of all tuberculosis cases.
53, or	7.4	per cent, of all diphtheria cases.

In addition to these, there were six other cases affected with tuberculosis of the intestines or of the mesenteric glands, together with a tubercular affection of the lungs.

With 30.7 per cent of so many tuberculosis cases showing primary lesions in the intestines or mesenteric glands, the argument against infection by ingestion of tuberculous food which was raised by Koch and based upon German statistics appears to be greatly weakened.

Gottstein,[28] in a recent statistical study relative to the etiology of tuberculosis, concludes that among children in Berlin the mortality of those at the breast is but slightly more than half as much from tuberculosis as among those otherwise nourished, the proportion, as he finds it, being as 6 to 10. He also finds, in studying the statistics of 23 large cities and university cities, where the returns are especially reliable, that whereas there has been a reduction of the mortality at all ages from tuberculosis, this reduction has been distinctly less in children under 15 years of age than in persons over that age. From this he concludes that "the thought is not to be set aside that in the etiology of tuberculosis in children and in grown people very important differences must occur. There must be assumed for the infection of children another source than for that of grown people, and it certainly is natural to conclude from the difference established statistically that the source of children's tuberculosis is to be sought partly in nourishment with milk containing tubercle bacilli, while the decrease since 1894 is to be traced back to the better general and individual prophylaxis in the care of milk."

An examination of the vital statistics of Massachusetts and Michigan, the only States from which sufficiently complete records were received, indicates a tendency of the same nature in the development of tuberculosis in the United States. In The Vital Statistics of Massachusetts, 1853–1895, the two years 1856–1857 are contrasted with the two years 1894–1895. In the two years first mentioned, for the period

under 5 years of age, there were 46.3 deaths from pulmonary phthisis to 1,000 deaths from all causes. In the two years last mentioned there were but 15.6 deaths from pulmonary phthisis to 1,000 deaths from all causes, or one-third as many. This is a very gratifying reduction in the phthisis death rate. Let us see, now, how it is with other forms of tuberculosis. In the two years first mentioned there were in the same age class 70.7 deaths from other forms of tuberculosis to each 1,000 deaths from all causes; and in the two years last mentioned there were 96.2 deaths from other forms of tuberculosis to each 1,000 deaths from all causes. That is, in this forty years there appears to have been an increase of 36 per cent in the forms of tuberculosis other than phthisis in the class under five years of age, while there was a reduction in the mortality of phthisis at all ages of about 45 per cent. The vital statistics of Michigan show that in that State during the years 1870 to 1884, inclusive, taking the class under 5 years of age, there were for each 100 deaths from consumption 81.8 deaths from other forms of tuberculosis; during the years 1885 to 1897, inclusive, there were 104.3 deaths from other forms of tuberculosis to each 100 from consumption, while during the three years 1898 to 1900, inclusive, there were 263.3 deaths from other forms of tuberculosis to each 100 from consumption. Why this tremendous increase in mortality from other forms of tuberculosis as compared with consumption at what has well been called the milk-drinking age of life?

Another important question which was discussed by your committee in its last report has reference to the possibility and frequency of tubercular infection through contaminated food when the primary lesions are elsewhere than in the abdominal cavity. The frequency with which infection may occur through the walls of the upper air passages, and particularly those of the naso-pharynx and pharynx, was shown. From recent experiments it appears that there is very likely another channel by which such infection may readily occur. It is a common observation that tubercle bacilli may penetrate the intestine and produce tubercles in the mesenteric glands without causing any lesions at the point where they pass through the intestinal wall. It has been frequently held, however, that they could not enter the thoracic duct and the blood vessels without first passing through and being arrested by a lymphatic gland.

Dobroklonski[29] in 1890 conducted some investigations from which he concluded that tuberculosis may certainly affect the organism by the digestive tract. For this infection to occur it is not necessary that there should exist a lesion of the intestinal wall, an epithelial desquamation, nor any local modification whatever, nor an interior inflammatory process. The tubercular virus (bacilli as well as spores) may easily traverse the completely normal epithelial lining of the intestine. The tubercle bacilli as well as their spores, unless they remain a long time in contact with the intestinal wall, are not capable

of causing inflammatory processes in this wall, nor modifications of the epithelial coat.

In 1895, Desoubry and Porcher [30] made investigations with dogs to learn if microbes of various kinds may pass through the intestinal wall and enter the thoracic duct. They took chyle directly from the cistern of Pecquet, and also blood from the portal vein. In both cases they demonstrated the presence of bacteria. The species were not determined, but they observed cocci, bacteria, and bacilli. They say, in conclusion, it seems to follow from their experiments that microbes may follow the lumen of the chyle vessels. Every time that the animal received either fat or milk they constantly found bacterial species in the chyle. They ask, may we not infer from this that the microbes pass into the chyle vessels by means of the globules of fat?

Quite recently Nicolas and Descos [31] have experimented in a similar manner after feeding tubercle bacilli to dogs. These investigators fed a soup composed of from 1 to 1½ liters of milk, according to the size of the animal, from 80 to 100 grams of fat, and about 100 grams of bread to dogs which had fasted 24 to 36 hours. The animals were killed from 3 to 3½ hours later. The chyle for examination was taken from the cistern of Pecquet or the thoracic duct. After each experiment a complete autopsy was made to assure the authors that the animal did not possess any tuberculous lesion and that the intestine was perfectly normal. The presence of tubercle bacilli was demonstrated by the coloration of the microscopic preparations and by the inoculation of guinea pigs. Positive results were obtained by both methods. The authors conclude as follows: The essential fact brought out by these experiments is that three hours after the ingestion of tubercle bacilli the chyle and the lymph of the thoracic duct may contain bacilli and even virulent bacilli in a sufficient number to cause tuberculosis in the guinea pig. They think it quite interesting to know that this may occur under conditions which approach quite closely those of a child fed with tuberculous milk.

To recapitulate, recent investigations show that—

(1) While the bacilli of human tuberculosis are often of feeble virulence for cattle, there is a considerable proportion of cases in which these bacilli are virulent for cattle as well as other animals.

(2) Bacilli of both the bovine type and the human type have been obtained from cases of human tuberculosis.

(3) Bovine bacilli introduced into the human tissues by accidental inoculation have lived, multiplied, and produced disease at the point of inoculation, and have been recovered after a considerable time with their vitality and virulence unimpaired.

(4) Various statistical studies indicate that a considerable proportion of the cases of human tuberculosis, and particularly with children, originate through the ingestion of the bacilli with contaminated food.

It appears to your committee, therefore, that the conclusions of Koch, announced at the British Congress on Tuberculosis, to the effect that bovine and human tuberculosis are different, that human tuberculosis can not be conveyed to cattle, and that man is insusceptible to bovine tuberculosis are disproved and should no longer have weight with sanitarians. The evidence brought forward indicates that greater care should be exercised to prevent human infection with bovine tuberculosis, and particularly to guard children from tuberculous milk.

RABIES.

Rabies is an extremely dangerous disease, which continues to exist in many parts of the country without any very vigorous or systematic efforts being made to repress it. In the past, doubts have been raised by some pathologists as to the specific nature of rabies and particularly as to the transmission of this disease from dog to man. Inoculation experiments have, however, settled this question beyond any reasonable controversy, and it is time for progressive sanitarians to accept this fact and to turn their attention to measures of prevention. The one method of controlling this disease which the experience of the world has shown to be most efficacious—namely, the muzzling of dogs in the infected district—can not usually be enforced in this country, because of the ignorance of our people concerning the disease and the popular prejudice against any measure which appears to cause the least discomfort to these animals. In considering this matter, it appears that the medical profession has contributed somewhat to the popular errors concerning this disease, by uncertainty within its own ranks and by failing to take as decided a stand as it should upon a question of such great importance. This being the case, it is all the more necessary that the profession should now accept unreservedly the facts brought out by scientific investigation, and teach the public that there is such a disease as rabies, that it is a common disease, that it is communicable from dog to man, and that the muzzling of dogs is the only efficient method of eradicating it.

Koch's reference to this disease in his address before the British Congress on Tuberculosis has apparently been lost sight of because of the many other questions which he discussed that were more closely connected with the object for which the congress was called. His remarks with reference to hydrophobia, however, tersely expressed the experience of Germany and are worthy to be remembered by every health officer and by every physician who desires to hold and to teach correct views. Koch says:

Hydrophobia, too, is not void of instruction for us. Against this disease the so-called protective inoculation proper has proved eminently effective as a means of preventing the outbreak of the disease in persons already infected, but, of course, such a measure can do nothing to prevent infection itself. The only real

way of combating this pestilence is by compulsory muzzling. In this matter also we have had the most satisfactory experience in Germany, but have at the same time seen that the total extermination of the pestilence can be achieved only by international measures, because hydrophobia, which can be very easily and rapidly suppressed, is always introduced again year after year from the neighboring countries.

The State board of health of Minnesota had knowledge of 85 cases of rabies in that State in 1901, namely, 10 dogs, 70 cattle, 4 hogs, and 1 horse. In 1902, to November 1, there were recorded in that State 73 cases of rabies in animals, namely, 19 dogs, 16 cattle, 37 hogs, and 1 horse. During the latter period 4 people were known to have been bitten by rabid animals and one death resulted. This, however, by no means represents the total number of cases of rabies in the State during the period referred to, but only those which happened to come to the attention of the board.

The Bureau of Animal Industry, during the fiscal year ended June 30, 1902, made a positive diagnosis in 25 cases of rabies occurring in the District of Columbia or in the immediate vicinity. One of these was an unfortunate woman who was bitten by a dog, but who did not know that the dog was rabid and consequently did not take the Pasteur treatment. Nineteen cases were diagnosed in dogs, 3 in cows, 1 in a hog, and 1 in a horse. There are no measures enforced at the national capital for the suppression of this disease.

GLANDERS AND ANTHRAX.

There are some other diseases of animals communicable to man, which unfortunately are far too prevalent. One of these is glanders. This disease is widely distributed, and measures for its control are either insufficient or entirely lacking, according to locality. A considerable number of human lives are lost every year by infection with the glanders bacillus. Bracken reports that three cases have been reported from the laboratory of the Minnesota State board of health during the past six months. Case 1 was infected directly from a glandered horse. Case 2, a brother of the first-mentioned case, was infected in caring for his brother. Both of these patients died. Case 3 was infected in making an autopsy of a guinea pig inoculated from case 2. Infection apparently occurred through a slight cut on the finger. The first symptoms were suggestive of typhoid fever, but later three superficial and localized lesions developed, as did also a fourth point of localization still later. These were treated surgically and the patient is apparently progressing favorably. This series of cases illustrates the danger, not only to those who care for glandered horses, but also to those who care for human patients, and even to the laboratory workers who make the inoculation tests. It appears certain that there must be numerous cases of glanders in man which

are never properly diagnosed, and which consequently do not appear as such in the vital statistics.

Outbreaks of anthrax appear to be becoming more frequent and new centers of the disease are from time to time reported. The Middle, Western, and Northwestern States, while not so severely infected as the Lower Mississippi Valley, often report the plague sometimes in animals, sometimes in men. The long period that this infection may remain active in certain soils makes an outbreak in any locality a very serious matter, since it is never known when or how often the disease may reappear.

There should be great care in handling the carcasses of animals affected with either glanders or anthrax. All contaminated soil should be scraped up and buried with the carcasses, the whole being well covered with quicklime before the earth is filled in over them. Autopsies should be made with the greatest care to guard against infection, and the owners of affected animals should have the dangerous nature of these diseases fully explained to them. Health officers can do much to educate the public in these matters, and should seize upon the opportunity presented by an outbreak of disease to disseminate information while public interest is aroused.

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TAKOSIS, A CONTAGIOUS DISEASE OF GOATS.

A Preliminary Report on its Nature, Cause, and Prevention.

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PRELIMINARY REMARKS.

It will surprise many readers to learn that there exists a disease of any kind sufficiently virulent to kill a goat. As popularly regarded, this animal haunts the backyards and alleys in the suburban districts of our cities, where he picks up various articles of sustenance which would prove fatal if consumed by any other species of animal. Kept under these conditions, he usually presents such a cheerful and healthy appearance that he would at once be pronounced able to combat successfully anything that should come his way, even an infectious disease.

While admitting that the common goat (*Capra hircus*) is susceptible to comparatively few ailments, it will be shown by the following article that the Angora, after many generations of careful breeding and selection under favorable conditions, has developed a perceptible retrogradation in vitality and power of resistance against disease and has been seriously and fatally affected in many sections of the country by a disease not accredited to its prototype. During the fall and winter of the past year, reports of a chronic, highly fatal contagious disease, which seemed to threaten the Angora goat industry in certain districts, reached this Bureau from several different States; and, as the symptoms and postmortem lesions described in the letters were entirely unlike any of those accompanying the known diseases which affect this species of animals, arrangements were made to secure the viscera of an animal that had died after showing characteristic symptoms of the disease in question, in order to investigate the nature, and, if possible, the cause of the affection. As a result, the entire viscera, including the head and intestinal canal of a goat that succumbed to the disease, was received in good condition from Pennsylvania during December, 1901.

The inoculated culture media and cover-glass preparations made from the heart's blood, lungs, and spleen showed a small micrococcus

arranged in the form of a diplococcus, and occasionally in tetrads or short chains. Two other organisms were obtained from the liver and lungs—one a large spore-bearing rod and the other a motile, peptonizing bacillus; but, after a bacteriological examination and inoculation tests, they were shown to be obvious contaminations, the result of postmortem invasion. A similar study of the micrococcus isolated from the heart's blood revealed its pathogenic properties to mice and guinea pigs, and it was thereupon determined to make a more extended investigation of the disease. Shortly after, one of the writers was enabled to visit a large flock of Angora goats, among which the disease was prevalent, with deaths occurring daily, and it is principally from the information acquired from an investigation of the disease in this outbreak that this article has been prepared.

NAME OF DISEASE.

Takosis.—It is with considerable hesitation that a specific designation for the disease in question is suggested at this time, and although generally the coinage of names is to be avoided, still it seems essential and preeminently of importance to individualize this affection by means of a descriptive term. For this purpose the name Takosis is proposed. It is derived from the Greek *τήκω*, meaning to waste, to cause to waste away, and is thought sufficiently descriptive and accurate to meet the desired requirements.

HISTORY OF OUTBREAK.

On arriving at the farm where the Angora goats were kept, it was learned from the owner that goats had been maintained on the premises for several years, but the majority of the flock had been purchased in Texas six weeks before the outbreak. The disease had commenced its ravages in November, when the animals had been on brush land in the mountains. Laurel poisoning was suspected, as several goats had died from this cause during the previous summer, but on closer observation this opinion was disregarded, not only on account of the different symptoms manifested, but also from the chronic course of the disease. The general weakness, loss of flesh, and extreme debility of the animals then suggested intestinal parasites as the cause, and worm powders were administered for a period sufficiently long to obtain results, but without success. It was then thought desirable to change the pasture, and accordingly the goats were brought down from the mountains to the farm, where they were stable-fed. The majority were placed on the ground floor of a large hillside barn in various-sized pens to accommodate the several bunches into which the animals had been graded. The remainder were allowed the freedom of the yard and hillside and were stabled on the barn floor proper between two haymows. Feeding troughs and mangers had been erected, and this provision was in every way satisfactory for the purpose for which it

was designed. The barn, pens, and yards in which the animals were kept appeared to be in good sanitary condition and well adapted to the sheltering of goats. The feed consisted of corn, oats, and hay in ample quantities and in proper proportion, and the goats at all times took readily to this diet, even up to the time of death. In fact, it was a curious circumstance to observe, on postmortem examination of a large proportion of these animals, that the stomachs were filled with recently partaken food. And the goats could be seen eating hay sometimes with evident relish, at other times in a listless manner, when their vitality was so reduced as to make standing impossible. Despite the change from the mountain pasture, including an entire change of surroundings as well as diet, deaths continued with alarming frequency, and the services of the Bureau were solicited in combating the affection.

The continuance of the fatalities after a complete change of diet and shelter, the regularity of the course of the disease, the apparent similarity of the symptoms in all the affected animals as well as the evident spread of the affection from one animal to another, led the owner to be strongly suspicious that he was dealing with a contagious disease, and he therefore constructed a pen in a corner of the basement wherein all the affected goats were placed. This proved to be a step in the right direction, but the disease became so prevalent that an additional pen was brought into service. As no endeavor had been made to separate the latter hospital from the remaining pens, the results were not so beneficial as they might have been had this pen been entirely isolated, as was the original hospital. As it was, the larger unaffected does and bucks were able to hurdle the fence and thus carry the infectious principle back to the healthy goats. This was at once brought to the notice of the owner, and steps were immediately taken to keep the healthy animals out of the infected pen as well as to isolate more thoroughly the inclosed goats by securely boarding up these quarters. This method of segregating the diseased animals, together with the disinfecting measures adopted, probably resulted in confining the ravages of the affection to a minimum.

SYMPTOMS.

The disease presents many of the symptoms usually accompanying a parasitic invasion and is characterized by great emaciation and weakness, with symptoms of diarrhea and pneumonia. In the early stages of the affection there is usually little to indicate that anything is seriously amiss with the animal. The first observable symptom manifested is the listless and languid appearance of the animal, evidenced by its lagging behind the flock, and is usually accompanied by a drooping of the ears and a drowsy appearance of the eyes. The pulse is slow and feeble and the temperature is elevated slightly at first, but

becomes subnormal a few days before death. The highest temperature observed in the natural disease was 104.1°, and the lowest, in a prostrated animal a few hours before death, registered 99.7° F. Snuffling of the nose, as in a case of coryza, with occasional coughing is sometimes in evidence.

As the disease advances the animal moves about in a desultory manner, with back arched, neck drawn down toward the sternum, and with a staggering gait. Rumination is seldom impaired. The appetite, while not so vigorous, is still present, though capricious, and the affected animal shows plainly that the ravages of the disease are rapidly overcoming the restorative elements derived from the food. The fleece is usually of good growth and presents a surprisingly thrifty appearance when the condition of the animal is taken into consideration. All the exposed mucous membranes appear pale and the respirations are accelerated and labored. The goats finally become so weak that they are readily knocked down and trampled upon by their fellows. If picked up they may move off slowly and eat a little, but within a few hours are down again, and in this way linger for several days, shrinking to about half their natural weight, and occasionally bleating or groaning, with head bent around on the side or drawn down to the sternum. A fluid discharge from the bowels of a very offensive odor is usually observed in the last few days of life, but this symptom is not constant.

COURSE AND SUSCEPTIBILITY.

This disease may assume a subacute or chronic type, usually the latter. According to our own observations, the animal dies of inanition in from eight days to six or eight weeks. Several owners have reported deaths after only two or three days of illness, but the goats doubtless had been affected for a longer period, although not noticed on account of their mingling in the flock. It is the consensus of opinion among the breeders interviewed that many of the animals succeeded in living for weeks, but gradually became weaker and more debilitated, finally dying in a comatose condition. In no instance have we observed or heard of the natural recovery of an animal after once the symptoms of takosis were noticed.

The younger goats seemed to be the most susceptible to the disease, although the old animals were by no means immune. The does, wethers, and also the bucks became affected, and for a period of almost two months (December and January) newly diseased goats varying in number to as many as 11 were removed to the hospital daily on the Pennsylvania farm where the disease was investigated. Owing to the preponderance of does at this place, it appeared that the affection was most virulent for them, but this fact has not been sustained by reports subsequently received from other sections.

PATHOLOGICAL ANATOMY.

As already indicated, the general appearance of the carcass simulates that produced by a wasting disease. The visible mucous membranes are pale and anemic, while the fleece, which appears somewhat dry and lusterless, furnishes a shroud for the extremely emaciated condition that becomes plainly perceptible on skinning. This masking quality of the hair prevents an accurate estimate of the condition of the animal by the eye alone, and necessitates handling of the individual to appreciate to the full extent the inroads made by the affection. The same anemic condition of the subcutaneous and muscular tissues is observed on eviscerating the carcasses. The lungs in most cases are the seat of a peculiar diversified inflammation, never of a remarkable extent. The external appearance of these organs is at times mottled, caused by a few congested areas, several patches of an iron-gray color similar to areas of pneumonia during the process of absorption, and normal tissue. On section through the reddened patches, a frothy mucus may exude from the bronchioles, and in one case numerous punctiform hemorrhages were observed on the sides of the incision. This tissue, while not so buoyant as a normal portion would be, nevertheless floats when placed in water.

The heart in all cases is pale and dull, its tissue soft and flabby, while inflamed areas, more or less penetrating, are present at times on the epicardium about the auricular appendages, and at other times on the endocardium, especially that lining the ventricles. These hemorrhagic patches consist of either pure extravasated blood or blood mixed with serum, which gives them a more diffuse appearance and a gelatinous consistence. The pericardium is slightly thickened, and usually contains a small increase of fluid tinged with blood. The liver usually appears normal, although the gall bladder is frequently distended with pale-yellow watery bile. The kidneys are anemic and softened. The cortex appears slightly thicker and paler than normal, and contrasts strongly with the darker pyramids. The capsule strips off easily from the parenchyma of the organ. In one instance several pale areas simulating anemic infarcts were observed under the capsule extending into the cortex, which probably resulted from the compression of the capillaries by the swollen parenchymatous cells. The presence of albumin in the urine was detected by the nitric-acid test. The spleen appears atrophied and indurated, and on section the fibrous tissue far exceeds the splenic pulp. Attachments by fibrous adhesions may fix the spleen to the diaphragm or the neighboring organs. The intestines may contain normal fecal matter or semifluid feces of a disagreeable odor. The surface of the mucous membrane is at times covered with a slimy mucus or plastic exudate, and the appearance is that of a chronic catarrh associated with necrosis of the mucosa. The brain and spinal cord of four cases were examined, but without discovering any apparent alterations. As an illustration of the ravages

of this disease, the following brief notes are recorded upon two Angora goats which were sent from the same flock to the laboratory in order that work previously done and facts already established might be confirmed.

The larger of these was a female, one year old, greatly emaciated, and was at no time after its arrival at the laboratory able to stand alone, even when lifted up and placed on its feet. It was still able and willing to eat and drink, but it showed plainly that the ravages of the disease were rapidly getting the best of the reconstructive forces. The fleece was of good length, and appeared more glossy than that naturally found on animals so seriously emaciated. All of its exposed mucous membranes were pale. Temperature subnormal, pulse imperceptible, and heart's action feeble and irregular. Occasional bleating was heard, and the goat seemed in great distress. Because of the helpless condition of this animal it was killed the second day after its arrival, and at the autopsy the following conditions were noted:

Muscular tissue pale and anemic; lymph glands enlarged, but of normal color; the superficial inguinal glands were especially noticeable in regard to this condition. The lungs were affected throughout with a finely diversified pneumonia. There were three small areas (0.5 cm. to 2 cm. in diameter) of complete hepatization irregularly located near the surface of the left lung, while the remaining portions of both lungs were grayish red in color. The pleura showed no lesion. The heart muscle was pale, and directly beneath the epicardium were a number of dark hemorrhagic areas which ranged in size from a pin head to a large bean.

The pericardial sac contained from 250 to 300 c. c. of slightly reddened nonviscid fluid. Liver apparently normal. Spleen shrunken and pale. The kidneys appeared anemic and somewhat flabby. The bladder contained about 30 c. c. of albuminous urine. The small intestines were inflamed and their internal surface was covered, wherever the inflammation existed, with a slimy, malodorous deposit. The stomachs and large intestine were normal, as were also the brain and spinal cord. The general appearance of the affected animal would lead one to suspect a verminous affection of the alimentary tract. The emaciated, anemic condition of the animal, as well as the persistent appetite associated with diarrhea, would strengthen such an opinion. For this reason a careful examination of the stomachs and intestines was made. The only result, however, was the discovery of three specimens of the comparatively harmless *Cysticercus tenuicollis*, which were attached to the external surface of the rumen. There was no trace of animal parasites to be found in the stomachs, intestines, or other organs.

Cultures made from the heart, lungs, spleen, liver, and mediastinal lymph gland proved positive, and in most of these instances the micrococcus was grown at once in pure culture.

The smaller of the two goats received at the laboratory during the latter part of March was a wether about one year of age. It was much emaciated but still active on its arrival. Its appetite was unimpaired. Physical examination made on the day previous to its death showed a temperature of 102.5° F.; respiration, 32; pulse, 112, irregular and somewhat fluttering. The exposed mucous membranes were pale and the eyes dull and lusterless.

This animal died on the third day after its arrival at the laboratory. At the postmortem examination there was found to be general emaciation of the muscular tissues, which appeared whitened and bloodless. About 200 c. c. of fluid was present in the pericardial sac. It was reddish, thin, and appeared like greatly diluted blood. The lungs floated in water, but presented the same grayish red appearance that has already been noted in the lungs of its mate. The spleen was small, pale, and firm. The kidneys appeared swollen and anemic. The bladder was empty. The liver showed no lesions. The mucosa of the abomasum was slightly congested. The intestines were empty throughout, and appeared but moderately inflamed in the region of the duodenum and jejunum. The rumen contained a large quantity of undigested food and was in a normal condition. The brain and spinal cord presented an equally healthful appearance. Search for animal parasites was without result, although the visceral organs were carefully scrutinized.

Positive cultures were obtained from the pericardial and peritoneal fluids and from the liver and lungs.

BACTERIOLOGY.

During the visit to the affected flock several goats were slaughtered in various stages of the disease and tubes of agar media (on account of their ease of transportation) were inoculated from the various organs and heart's blood as well as cover-glass preparations obtained from the juices of these tissues. Subsequent examination of the cultures and slides showed the presence of a micrococcus, usually arranged in the form of a diplococcus, which was found to be in pure cultures from the heart's blood, spleen, kidneys, and pericardial fluid, and essentially so in the tubes inoculated from the other organs. Inoculations made from the spinal cord were negative. Identical organisms have since been obtained from Angora goats affected with the disease from several different localities and their identity proved by cultural examination and inoculation tests. Various other micrococci to which the one under consideration bears a resemblance were carefully compared, but we have not been able to identify the latter with any of the previously described organisms, although it presents in a parallel series of cultures many characteristics in common with the *Staphylococcus pyogenes albus*. Owing to the scarcity of any preeminently conspicuous lesion in the affected goats, and to the absence of any

Description of Plate XLIII.

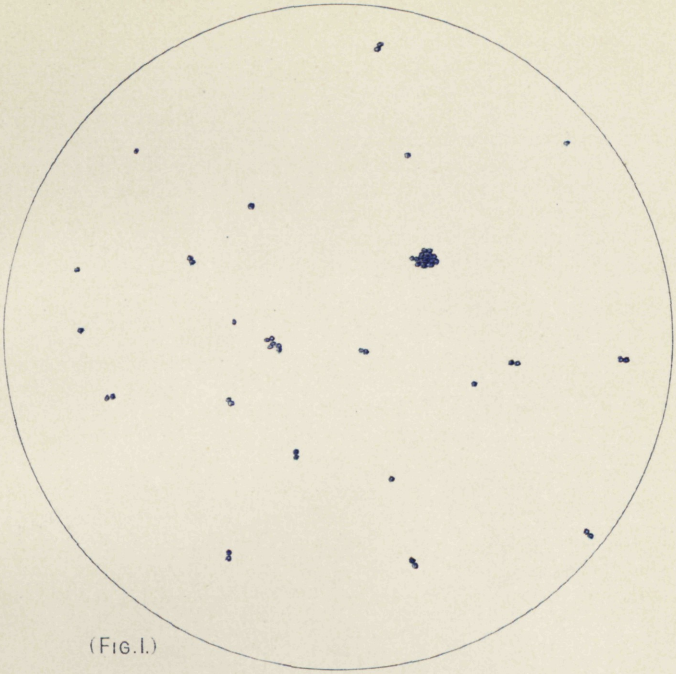
Fig. 1. Twenty-four-hours'-old bouillon culture of *Micrococcus caprinus* stained with gentian violet. Camera lucida drawing made at stage level with Zeiss No. 4 compensating ocular and 2 mm. oil immersion.

Fig. 2. Forty-eight-hours'-old milk culture stained with gentian violet. Camera lucida drawing made at stage level with Zeiss No. 4 compensating ocular and 2 mm. oil immersion.

Description of Plate XLIV.

Fig. 1. Cover-glass preparation from lung of goat No. 2, dead as a result of natural infection. Stained with gentian violet. Camera lucida drawing made at stage level with Zeiss No. 4 compensating ocular and 2 mm. oil immersion.

Fig. 2. Cover-glass preparation of blood from posterior auricular vein of Angora goat No. 23, removed aseptically seven days before death from takosis. Stained by Gram's method, followed with eosin. Drawing with camera lucida at stage level with No. 6 compensating ocular and 2 mm. oil immersion and increased six diameters.



(FIG. I.)

(FIG. 2.)

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MICROCOCCUS CAPRINUS FROM
(1) BOUILLON AND (2) MILK CULTURE MEDIA

(FIG.1.)

(FIG.2.)

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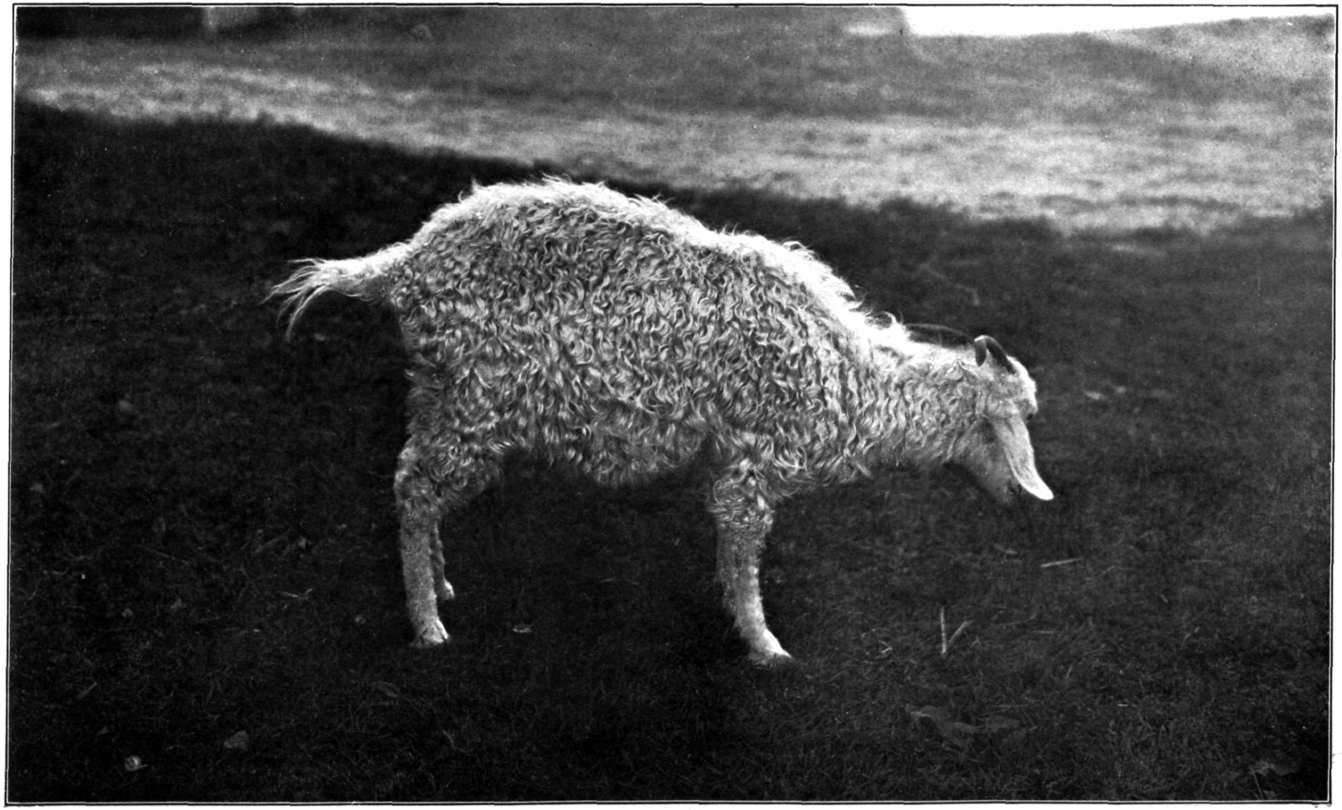
MICROCOCCUS CAPRINUS FROM THE
(1) LUNG AND (2) BLOOD OF ANGORA GOATS



Angora Goat No. 27, Six Days Before Death from Takosis.

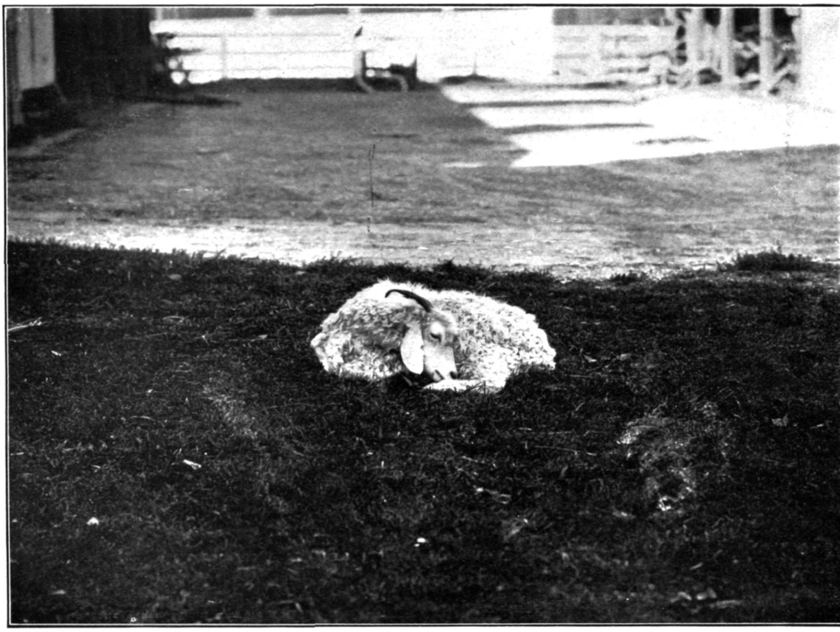


FIG. 1.—ANGORA GOAT FROM MARYLAND FLOCK. PHOTOGRAPHED THREE DAYS BEFORE DEATH.

FIG. 2.—SAME AS FIG. 1. POSITION ASSUMED AFTER EXHAUSTIVE EFFORTS TO REGAIN ITS FEET.

Angora Goats Nos. 31 and 32, Affected with Takosis. Photographed Twenty-four Hours Before Death.

typical morphologic or cultural characteristic of the micrococcus, it was thought desirable to derive its name from its host, especially as it did not appear to be pathogenic for pigs, dogs, and chickens which fed upon the diseased carcasses on one of the infected premises, or for horses, cattle, and sheep that were quartered in an adjoining portion of the same stable. Therefore the name *Micrococcus caprinus* sp. nov. is suggested.

MORPHOLOGY.

The specific organism of takosis appears in fresh bouillon cultures as a spherical or oval micrococcus with a diameter of 0.8 to 1 μ. In these cultures it is single or in chains of two, three, or four elements, but most frequently in pairs, as diplococci (Pl. XLIII, fig. 1), with a diameter transverse to the axis of the chain greater than the longitudinal diameter. There is quite a variation in the size of the cocci, probably due to the increase in the size of the organism preparatory to the act of fission. As the cultures become older the cocci develop a stronger tendency to form chains, and after remaining in the incubator at 37° C. for three or more days chains of four to six elements are at times observed, as are also irregular clumps of cells which collect in masses of varying sizes. When they assume this grouping tendency no oval forms are to be found and each of the organisms is strictly spherical in outline. In the tissues they are frequently seen to deviate from the spherical and assume somewhat of a lancet shape, with the pointed extremities in apposition. This same form has been met in samples of blood freshly drawn from the ear of an affected goat. The elements forming pairs are frequently very unequal in size and are not always of uniform shape. (Pl. XLIV, fig. 1.) They are seen to possess the ability of executing strong Brownian movements, but make no progress across the field of the microscope. No capsule has been observed surrounding these micrococci either in the blood or when obtained from cultures, nor have spores, vacuoles, or crystals been seen. The organism stains indistinctly and with difficulty with Loeffler's methylene blue and the standard aqueous aniline dyes, with the exception of gentian violet, but carbol-fuchsin and Gram's and Gram-Weigert's stains give clear uniform coloration to the cells.

BIOLOGY.

The organism develops as an aerobe, but it also supports an active growth when deprived of oxygen, and is, therefore, a facultative anaerobe. It grows both on solid and in liquid culture media, with the usual degree of alkalinity, but also multiples in those that give an acid reaction of +1.5 phenolphthalein.

A temperature of 37° C. is most favorable for its development, but it will also grow at room temperature. In the latter case the growth is more tardy and not so profuse.

CULTURAL CHARACTERISTICS.—*Bouillon.*—In neutral (phenolphthalein) peptonized beef broth a slight uniform cloudiness is caused by the growth of the organism within ten hours at 37° C. This condition increases until, after twenty-four hours at the above temperature, the cloudiness has become quite marked and uniform. At this time a deposit may be noticed beginning to gather on the bottom of the tube. In three days this sediment has increased in volume and the turbidity of the supernatant fluid has been lost. The deposit is pearl-gray in color, and on agitating the tube it rises slowly in the shape of a twisted, ropy, coherent mass. A delicate marginal ring on the side of the tube is usually produced. No pellicle is formed, nor can any characteristic odor be detected. The reaction of bouillon in which this organism has been growing for five days becomes decidedly acid, +1.7 phenolphthalein, and continues to increase in acidity subsequently.

Agar.—Growth upon the surface of slant agar occurs in twenty-four hours in the form of a white, glistening granular streak composed of numerous confluent colonies. This narrow line of growth becomes more extensive and reaches its maximum width on the third or fourth day, when it shows a ceraceous, at times granular, surface, with irregular wavy margins. In stab cultures the growth appears within twenty-four hours as profuse, small, grayish white, closely aggregated globules, so densely packed together as to give an irregular nodulose appearance macroscopically along the entire length of the line of puncture. The only colony which develops at the point of entrance of the needle is at first pearly white, but after twenty-four hours it assumes a grayish color in the center, with a lighter periphery of an equal breadth. It has a slightly granular center, a regular border, and is from 8 to 10 mm. in diameter. The surface growth on agar plates appears as smooth, white, flatly convex, ceraceous colonies, about 1.5 mm. in diameter, with entire borders. By reflected light these surface colonies appear homogeneous, but observed by transmitted light they present a white center and pearly margin. The submerged colonies develop as light brownish foci with regular outlines. They may be round or lentil shaped, but are always minute in size. No characteristic differences in growth of this organism have been observed when sown on glycerin-agar or on serum-gelatin-agar.

Gelatin.—In this medium the growth is slower, evidence of fertility not appearing until forty-eight hours. In stab cultures the line of puncture is occupied by numerous nodulose milk-white colonies that have apparently coalesced, and which extend to the extreme end of the tract. When examined by the aid of the hand lens, they appear as closely aggregated individual colonies, with regular outlines and presenting a beaded appearance. These colonies are more minute than in agar, and the growth that appears on the surface, though similar in consistence, is likewise thinner and less profuse than parallel agar

colonies. The organism will not liquefy gelatin until several generations have been grown upon artificial media. After a number of subinoculations the peptonizing of the gelatin commences on the seventh or eighth day, and later as early as the fourth or fifth day, when the surface growth is seen to sink, following which liquefaction is very rapid, and may reach the bottom of the tube in forty-eight hours, leaving a funnel-like track in its wake. The adjoining medium is then attacked, and within ten days after inoculation the contents become fluid, with a white pellicle on the surface. The appearance of the gelatin-plate colonies which develop on the second or third day is probably of a more milk-white color and thinner and slightly smaller than those in agar, but otherwise are similar. Liquefaction does not commence until the fourth or fifth day, sometimes the seventh day, and this occurs only after continued subinoculations.

Blood serum.—The organism grows steadily on coagulated blood serum. The colonies coalesce, forming a narrow, compact line of whitish color, with edges slightly elevated above the level of the body of the growth. The water of condensation at the base of the serum slant is clouded and contains a white sediment. As the cultures become older, or after seven or eight days' growth, they assume a brownish color. In this work the serum used was obtained from the blood of a dog and was freshly prepared immediately preceding its use.

Potato.—When a loopful of a vigorous bouillon culture is sown upon the surface of potato, the growth that ensues along the line of inoculation inside of thirty-six hours is slight, moist, and glistening. In forty-eight hours it appears granular and rather feeble, like a cluster of dewdrops. Growth ceases by the third day, at which time the granular surface, with the aid of the hand lens, appears to be made up of minute individual raised colonies of a ceraceous nature that have become confluent.

Milk.—Growth develops rapidly when tubes of this medium are inoculated, but the only manifestation of the development during the first twenty-four hours is a slight deposit observed at the bottom of the tube. No change occurs in the appearance of the milk until the third or fourth day, when the medium becomes firmly coagulated in one mass. Within the following twenty-four hours the coagulum becomes partially peptonized and a transparent odorless whey is collected at one side of the slightly inclined tube, or at the top if the tube is kept in a vertical position. This separation has been observed in various instances to commence from the fourth to the eighth day, and is usually completed after twenty-four to thirty-six hours, at which time the solid curd takes up from one-third to one-half of the volume of the medium, and either adheres to one side or occupies the bottom of the tube.

Litmus milk is changed to a delicate pink on the third day, owing to the development of acids, but no coagulum occurs until the fourth

or fifth day, when a similar separation of the curd and whey takes place as in plain milk, with a greater tendency of the coagulum to form flocculi.

Fermentative action.[a]—The growth in bouillon, to which 1 per cent lactose, dextrose, and saccharose has been added, is rapid, especially with saccharose, but without any formation of gas. Inside of twenty-four hours the bulb becomes uniformly turbid in all these fluids, with a slight sediment in the branch and the appearance of growth at the extreme bottom of the closed tube. A faint marginal ring, but no pellicle, is observed. After three or four days, the closed branch is uniformly clouded throughout, and remains so until the partial gravitation of the suspended elements, which occurs in six or seven days. Lactose bouillon cultures develop 5.1 per cent acid in growing for five days at 37° C., while dextrose cultures produce 3.9 per cent and saccharose bouillon cultures 3.5 per cent acid in the same time and under the same conditions. In sixteen days these media gave, respectively, a reaction of 7.7 per cent, 5.5 per cent, and 10.1 per cent. After thirty days' development the production of acid in lactose, according to the phenolphthalein test, was 9.2 per cent, dextrose 6.2 per cent, and saccharose 11.8 per cent. The production of acids is constant in all media.

Indol.—Cultures that have grown in Dunham's solution for two, seven, ten, and thirty days, respectively, were tested for the presence of indol by the method of Kitasato. In each case the result was negative.

Phenol.—Bouillon cultures of ten days' development, when submitted to Weyl-Lewandowski's test for phenol, threw down a precipitate of fine crystals which by microscopic examination proved to be phenol. The distillate failed to show the reaction for indol.

Thermal death point.—Tubes containing 1 c. c. each of bouillon cultures of a twenty-four hours' growth were exposed to a temperature of 50° C. for varying periods of time, and fresh tubes of bouillon inoculated from them immediately afterwards. By this means it was shown that the tube which remained in the bath for three hours and fifteen minutes produced growth, although it was slight and tardy and the germ was evidently attenuated, while all that were exposed for three hours and twenty minutes or longer remained sterile. At 58° C. growth fails to occur after an exposure of only ten minutes. At 62° C. the organism was killed in six minutes, while it resisted a temperature of 70° C. for three minutes.

Desiccation.—The results obtained by the desiccation of the germ for twelve hours in the incubator at 37° C., with its subsequent exposure to the diffuse light of the room for a period of nine days, were sufficient to prove that sterility is thus produced.

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[a] The titre of these media was 1 phenolphthalein.

Temperature requirements.—As previously mentioned, this micrococcus develops profusely at incubator temperature, while at 20° to 22° C. the growth is more tardy and less profuse. The maximum temperature at which the organism would multiply was found to be between 45° and 46° C. No growth developed at 47° C.

Effect of low temperature.—Tubes that were placed in a freezing mixture twice daily and kept in the ice chest under these conditions for four days were subsequently incubated at 37° C., with the result that they became fertile in every instance.

Action of disinfectants.—When the organism was subjected for twenty-six minutes to a 1–2,000 solution of bichloride of mercury, no growth followed, but an exposure to a 1–1,000 solution proved fatal in thirty seconds. A 1 per cent solution of carbolic acid sufficed to prevent development only after an exposure of fifty-seven minutes, while a 2.5 per cent solution caused the death of the micrococcus in thirty seconds. Formalin, in the strength of a 2 per cent solution, required an exposure of thirty-one minutes to prevent the subsequent development of the organism. These disinfecting solutions were all used at room temperature (about 21° C.).

PATHOGENESIS.

In order to demonstrate the pathogenic properties of the *Micrococcus caprinus* and to establish its etiological significance in the disease in question, the following inoculation experiments were conducted upon white mice, white and brown rats, guinea pigs, rabbits, chickens, dogs, sheep, and goats.

EXPERIMENTS ON MICE.

Subcutaneous.—On January 11 a white mouse was inoculated intramuscularly near the base of the tail with 0.1 c. c. of an original bouillon culture from the spleen of Angora goat No. 2. In a few days it became languid and soon developed a diarrhea which terminated in death on the twelfth day. The postmortem showed the small intestines to be greatly darkened and inflamed. The lungs presented localized areas of congestion. The kidneys were enlarged and anemic and the spleen dark and swollen. The specific organism was recovered in pure culture from the lungs, heart, and spleen.

Intraabdominal.—The second mouse was inoculated intraabdominally on July 30 with 0.1 c. c. of a culture (sixth generation) which had been originally obtained from the lung of guinea pig No. 798 on February 2 and had been subjected in the meantime to repeated transplanting on slant agar. On August 2 the mouse was dull and stupid, with hair ruffled, and it remained crouching under the cotton in its cage the entire day. These conditions were very manifest on the following day, and on August 4 purging was established, which also con-

tinued on the 5th. The mouse was very languid and quiet on August 6 and 7, and died on August 8, nine days after the inoculation.

On postmortem the heart, liver, and lungs appeared normal. The intestines were inflamed and empty. The spleen was light in color and somewhat swollen. The glands of the lymphatic system, especially those of the throat and neck, were enlarged and congested.

Ingestion.—Mouse No. 3 was fed for four days, beginning July 30, upon bread that had been moistened with 8 c. c. of a bouillon culture of the same description as that used in the preceding test. On August 7 the mouse began purging, which continued until August 9, when it died. The autopsy showed that the lesions were confined to the digestive organs, the heart and lungs appearing normal. Cultures of the micrococcus were recovered from the heart, liver, and kidneys of the two last-mentioned mice.

EXPERIMENTS ON RATS.

Both the white and brown rats appear to be totally immune, although submitted to subcutaneous and intraabdominal inoculations with 0.5 c. c. of fresh virulent cultures. They evinced no apparent disturbance of any of their organic functions.

Feeding experiments were likewise accompanied with negative results.

EXPERIMENTS ON GUINEA PIGS.

Guinea pigs have proved susceptible in every inoculatory case, and the course of the disease evinced by these animals is very typical. They show gradual emaciation and wasting, with symptoms of pneumonia appearing a few days previous to death. Numerous cases developed enteritis with its consequent purging, but this condition was by no means constant. Convulsions, which so frequently attack rabbits during the latter stage of this disease, were not at any time observed in the guinea pig. The peculiar form of pneumonia already noted as appearing in the goat is seen to affect the guinea pig with great regularity. The organism was readily recovered from the heart, lungs, liver, kidneys, and spleen; in fact, it was found to be distributed throughout the blood of the circulation. Examinations of the flocculent sediment occasionally found in the urine resulted negatively.

A few typical cases of the disease in guinea pigs as a result of various forms of inoculation may be briefly given as follows:

Subcutaneous.—On January 3 guinea pig No. 707 received subcutaneously 0.25 c. c. of a bouillon culture of twenty-four hours' growth from the spleen of goat No. 2. The animal soon began to give evidence of an insidious disturbance of its nutrition, which continued until January 26, when it died, having in the meantime gradually reached a condition of extreme emaciation. The organism was recovered from the lungs, heart, spleen, and mesenteric glands. The period

of life following the subcutaneous inoculation of doses ranging from 0.25 to 0.5 c. c. varied from sixteen to twenty-three days, and averaged twenty and one-half days.

Intramuscular.—On January 3 guinea pig No. 710 received 0.25 c. c. of the same culture used in the test with No. 707, injected intramuscularly. Eight days later, or on January 11, the animal died.

Postmortem examination showed the carcass seriously emaciated. Liver and spleen enlarged, lungs congested, and the kidneys pale and softened.

Intramuscular inoculations of from 0.25 c. c. to 0.75 c. c. of a twenty-four-hour bouillon culture resulted in the death of the guinea pigs in from eight to thirteen days, with an average of nine days.

Intraabdominal.—Guinea pig No. 801 was inoculated intraabdominally on January 20 with 0.75 c. c. of a bouillon culture from the spleen of goat No. 2. Nine days later the animal died and the postmortem examination disclosed the usual picture of a wasted carcass, occluded lungs, inflamed intestines, fatty degeneration of the liver, and anemic kidneys. The average period of life following an injection of 0.25 to 0.75 c. c. by this method was twelve days, although death occurred in some cases as early as the eighth and as late as the twentieth day.

Ingestion.—After being deprived of food for twenty-four hours, guinea pigs Nos. 1413 and 1417 were fed 40 c. c. of a twenty-four-hour bouillon culture soaked in bread crumbs. No deleterious results were observed as a result of this feeding experiment.

EXPERIMENTS ON RABBITS.

These animals possessed a certain degree of immunity, many of those used in the various tests remaining unaffected. Those that became ill showed a marked rise of temperature, which diminished slowly after reaching its crisis, and for twenty-four hours preceding death was subnormal. Diarrhea and wasting uniformly appeared, and the subject frequently died in convulsions or tetanic spasms.

Intraabdominal.—The intraabdominal inoculation of 1 c. c. of a bouillon culture produced death in twenty-five days. The postmortem examination showed the lungs to be normal, the heart pale and flabby, liver enlarged and hyperemic, with gall bladder greatly distended. Spleen shrunken and showed excess of fibrous tissue. Intestines contained much gas and a small amount of fluid ingesta. The mucosa of the small intestines presented a catarrhal inflammation. Pure cultures were obtained from these affected organs.

Intratracheal.—Rabbits Nos. 382 and 383 were injected intratracheally with 1.5 and 1 c. c. of a bouillon culture, which resulted in death on the twenty-ninth and twenty-second day, respectively. Rabbits Nos. 381 and 472, each receiving 0.5 c. c., remained unaffected. The postmortem examination of No. 382 showed the mucous mem-

brane of the trachea to be inflamed in patches, especially along the anterior portion. Both lungs were hepatized in numerous localized areas. Heart flabby, liver dark, and gall bladder filled with watery bile. Spleen indurated and reduced in size. Intestines catarrhal and empty. Bladder distended with albuminous urine.

On postmortem examination of rabbit No. 383 the hide was found to be very tightly attached to the subcutaneous tissue and extremely dry. The pharynx and trachea were inflamed throughout. Cephalic lobes of both lungs hepatized. The auricles were distended and the heart muscle pale. Spleen shrunken. Kidneys dry and flabby. Liver dark in color, with distended gall bladder. Intestinal contents fluid.

Culture-media inoculations were positive in both the above cases.

Intravenous.—Rabbit No. 219 was inoculated intravenously on January 3 with 0.5 c. c. of bouillon culture from spleen of goat No. 2. It remained unaffected.

On January 15 rabbit No. 233 received 1 c. c. of the second generation of a bouillon culture obtained from the spleen of goat No. 2. On January 23 it refused to eat, and on the following day it died in tetanic spasms. Microscopic and cultural examinations demonstrated the presence of the *Micrococcus caprinus* in the heart, lungs, and liver.

Ingestion.—After twenty-four hours' abstinence from food, rabbit No. 728 received the organism mixed in its food for two consecutive days, commencing on April 17. The animal remained unaffected for a period of three months, at which time it was withdrawn from the experiment.

Rabbit No. 296 was subjected to the same feeding test on April 17. On May 7 it seemed partially paralyzed in the hind limbs; had fallen away greatly in flesh, and was a mere skeleton. May 8, hind limbs fully paralyzed. May 11, died after a period of twenty-five days.

Postmortem examination showed the animal to be very anemic and emaciated. Lungs appeared reddened and filled with blood. Heart normal. Liver enlarged and greatly darkened, with the gall bladder distended with bile. Spleen showed an apparent atrophy and dryness of the splenic pulp. Kidneys of normal size, but pale in color. Bladder greatly distended and filled with albuminous urine. It was attached at its fundus to the cecum by frail bands of fibrous tissue. The ileum was likewise adherent to the parietal peritoneum and to the liver. The stomach contained normal food, but its mucosa was covered with a thick glutinous mucus. The stomach wall appeared tender and was readily torn. Its pyloric end and the beginning of the duodenum was greatly thickened and the mucosa inflamed and convoluted. Inflammatory mucus could also be observed throughout the entire extent of the small intestines. Cover-glass preparations from the juices of the liver and lungs showed the presence of the specific organism.

EXPERIMENTS ON CHICKENS.

The inoculation of fowls proved that the micrococcus possessed purgative properties for these birds, but in no case was the result fatal. Intravenous injections of 1 c. c. and subcutaneous inoculations of 3 c. c. were made on 4 chickens, with uniform results. On the day following the inoculation the fowls become dull and listless. On the second day they refuse their food and are affected with diarrhea, which may persist for forty-eight hours, but in no case under our observation did it last longer. Recovery of normal condition is rapid after cessation of the purging.

It may also be mentioned at this time that the carcasses of the goats having died of takosis on a Pennsylvania farm were fed by the owner to his chickens and hogs, but in neither case was any unfavorable result observed.

EXPERIMENTS ON DOGS.

These animals, like rats, appear to be totally immune from the action of the organism. They were subjected to intravenous inoculations of 0.75 c. c. of a fresh bouillon culture, but without developing any untoward results.

EXPERIMENTS ON SHEEP.

Sheep have proved nearly as resistant as dogs. Two animals received intravenously and subcutaneously 1 and 2 c. c., respectively, of a twenty-four-hour bouillon culture. In the case of each sheep there was a temporary rise of temperature following the inoculation, which lasted about twenty-four hours. These animals were kept under careful surveillance for thirty-eight days, and during that time no after-effect from the action of the organism was noted.

In connection with this experience it should be recalled that a number of Shropshire sheep were in immediate contact with the goats on the Pennsylvania farm where the disease was first observed. In no case have sheep contracted the disease by such exposure.

EXPERIMENTS ON GOATS.

Nicole and Refik Bey, when writing of an infectious disease which was decimating the flocks of goats near Constantinople, said that, although the disease spread rapidly from goat to goat when the sick were pastured with healthy animals, they had found goats in the laboratory to be very resistant to all attempts at artificial inoculation. The results in the present instance warrant us in fully indorsing their conclusion regarding the resistant nature of goats, especially the common goat, when subjected to similar conditions.

The first goat upon which inoculation tests were made was a large aged male that had spent much of his life in harness in the vicinity of this city. He received intravenously 2 c. c. of a three-day-old bouillon

culture on April 14, when his temperature was 102° F. There was no sudden marked change, but after several days 103.2° F. was recorded. The fever gradually subsided until normal was reached. No evidence of any effect from the inoculation, other than this rise of temperature, was noticed. On June 7 he was reinoculated intra-abdominally with 5 c. c. of bouillon culture obtained from the liver of a guinea pig which had died but three days previously. His temperature just previous to inoculation was 102° F., but it immediately rose until it reached 104.6° F. on the evening of the same day. On the following day 104° F. was recorded, 103.1° F. on the third day, and normal on the fourth. No indication of any other disturbance as a result of the inoculation was noticed at any time.

An aged female goat that had been previously kept in the city as a milk producer was inoculated intravenously with 5 c. c. of a bouillon culture (fourth generation) on June 20. Temperature at time of inoculation was 102° F. The first rise in temperature was noted on June 23, when 102.6° F. was recorded, with 103° F. on June 24. On the following day 103.4° F. was reached and the animal refused the greater part of its food. On June 26 inappetence continued and purging began, while the temperature dropped to 102.8° F. The following day, the seventh after inoculation, the patient was purging freely a quantity of slate-colored fecès. Temperature, 102.2° F. On the 28th, although the excreta were still soft and whitish in color, there was no distress from diarrhea. The animal still refused food. On the following day, the ninth of the test, the appetite began to return, and the goat soon recovered its normal condition.

On July 10 goat No. 14, a small mature female, received intra-abdominally 4 c. c. of a bouillon culture obtained from the heart of a guinea pig. During the four days following the inoculation the goat neither ate nor drank. The maximum temperature was reached on July 16, when it registered 103.8° F. On July 24 diarrhea, with whitish mucous discharge, developed, which persisted for seven days, during which period the patient's appetite was again greatly impaired and capricious. The condition and strength of the animal rapidly wasted away. She remained incumbent much of the time, and when obliged to move walked with a staggering gait. Her illness was so serious at the crisis of the attack that her ultimate recovery was a matter of great surprise to those who were caring for her. Her convalescence was rapid as soon as the diarrhea was overcome, and she soon began to eat well and to make daily improvement in flesh and spirit.

Goat No. 15, a young native female, was fed 200 c. c. of a bouillon culture on July 23 and a like amount on the day following. Aside from a transitory rise in temperature of 1.4° F., there was no result apparent.

Another experiment was made on a grade Angora goat, No. 1741,

tne subject being a young female which received intraabdominally, on October 2, 1 c. c. of a bouillon culture from guinea pig No. 1140, which was inoculated with goat bouillon culture. Her temperature reached its highest elevation on October 8, when it registered 104.5° F., and no material change was noted until the decline developed about twenty-four hours before death. October 10 the subject became dull and inactive and diarrhea began to make itself manifest. On the following day violent purging had become established, the feces being thin, watery, and nearly white in color, the animal at this time appearing noticeably shrunken and weakened. On October 12 the purging still continued and the subject began to manifest extreme weakness. On the morning of the following day, the eleventh day of the test, the animal died. No indications of any respiratory disturbance were evidenced at any time during the course of the disease, although the lungs were found to be affected at autopsy. On postmortem examination the carcass showed great emaciation of the muscular tissues, which appeared whitened and bloodless. The mucous membranes were anemic. The heart was seen to be pale, with a few slight petechial hemorrhages beneath the epicardium around the superior border of the ventricles. Pulsations had stopped during diastole, leaving the ventricles filled with blood. The lungs showed a moderate attack of the characteristic pneumonia. The liver appeared darkened in color, while the gall bladder was distended to the size of a man's fist. The fluid which caused this distension lacked the oily viscid characteristics of normal bile, but appeared like water of a greenish color.

The spleen of this animal was pale and shrunken to about one-half of its normal size. The kidneys were softened and anemic and the bladder contained albuminous urine. Rumen, reticulum, and omasum were, with their contents, in normal condition, but the mucosa of the abomasum showed a slight congestion, and a mucoid exudate was found to cover its entire internal surface. No food was found in the fourth stomach, its contents consisting of liquid only. A like congestion and slimy exudate were seen to extend through the duodenum. The large intestines were bloodless and empty, but the lymphatic glands of this region appeared slightly hemorrhagic. The blood vessels of the brain were somewhat congested, while the spinal cord presented nothing abnormal.

At the beginning of this experiment the weight of the goat was 45 pounds. Weighed again immediately after death, it was shown that there had been a loss of 7½ pounds during the course of the disease.

Pure cultures of the specific micrococcus were recovered from the tissues of this animal.

PRODUCTION OF TOXINS.

In order to ascertain if the micrococcus under consideration produced a toxin, a number of inoculation experiments were made both

with the sterile filtrate of bouillon cultures and with the sterilized cultures.

The filtrates used in this experiment were obtained by growing a flask of bouillon culture for ten days at a temperature of 37° C. Afterwards the culture was filtered through a Chamberland filter (F), and, if proved sterile by media inoculations, the filtrate was then ready for use.

Four guinea pigs were used, each receiving the filtrate subcutaneously. No. 1151 received 1 c. c. of the filtrate February 25, but because of an accident it was necessary to remove the animal from the experiment before the test was completed. No. 1152 received 1.5 c. c. of the filtrate February 25, and seventeen days later, March 14, an inoculation of 0.5 c. c. of a virulent culture was injected. The guinea pig remained active and hearty, save for a temporary disturbance following the inoculation on February 25, until October 16, when it suddenly succumbed to an attack of pneumonia. The carcass was not emaciated, but, on the contrary, was well supplied with fat. Cultures made from the various organs failed to produce the *Micrococcus caprinus.*

No. 1153 received 2 c. c. of the filtrate on February 25, and seven days later 0.5 c. c. of a virulent culture, which was followed by a reinoculation of 0.5 c. c. of virulent culture ten days afterwards. Shortly after the application of the first inoculation of filtrate the animal was affected by dullness and loss of appetite, but after three days these symptoms disappeared, and the animal recovered its previous condition of perfect health, which it retained until October 18, when it died of enteric hemorrhage. The carcass of this animal was well nourished and showed no traces of wasting, or emaciation. The lungs contained numerous circumscribed pigment areas, the remains of former hemorrhagic infarcts. As two hundred and twenty-eight days had elapsed since the animal received its first inoculation with a virulent culture of the *Micrococcus caprinus*, it was, of course, impossible to establish an indisputable relation between the lesions of the lungs and the action of this germ, but it is not at all impossible that these ecchymosed areas were former centers of inflammation resulting from the inoculation of March 14. Cultures made from the organs of this guinea pig gave negative results.

No. 1154 was inoculated with 3 c. c. of filtrate on February 25, which was followed by a rise of temperature and slight indisposition. Seven days later 0.5 c. c. of a virulent culture was injected, and ten days subsequently 2 c. c. of the filtrate. The general appearance of this animal for six weeks following its inoculation with virulent culture showed nothing amiss, but during the latter days of April it became affected with lameness in all its feet. Fissures gradually developed on the plantar surface of each foot, and the inflammation later extended to the joints of the legs. This condition continued to become more

aggravated until the animal died, on May 12. In addition to the lesions of the legs and feet, there was a slight dropsical effusion within the abdominal cavity at the time of holding the autopsy, but cultures obtained from the tissues failed to show the micrococcus under consideration.

The effect of heat upon the toxins was obtained by heating the filtrate for thirty minutes at 60° C. Four guinea pigs were then inoculated, respectively, with 1, 2, 3, and 4 c. c. of this material, at the same time that 4 others received the same quantity of the filtrate which had not been subjected to such heating. Three days later these 8 animals, together with 2 control guinea pigs, were inoculated intra-abdominally with 0.5 c. c. of virulent culture. The 4 guinea pigs receiving, respectively, 1, 2, 3, and 4 c. c. of the heated filtrate died in twenty-one, sixteen, nine, and twelve days, respectively, after the injection of the virulent culture, while the check animals lived for nine and thirteen days. Three of those guinea pigs that received the unheated filtrate are, at present writing, in an apparently healthy condition, while guinea pig No. 2832, that was inoculated with 1 c. c. of the filtrate and three days later 0.5 c. c. of a virulent bouillon culture, died of typical takosis on the seventeenth day.

It appears from these experiments that the unheated filtrate possessed bactericidal properties and conferred limited power to prevent an attack of takosis, but when subjected to a temperature of 60° C. for thirty minutes its toxin was presumably destroyed, as no protective action was observed following its use.

In order to test further (see also remarks on treatment, p. 388) the immunizing effect produced by the administration of the toxins in the filtrate, 5 c. c. of this fluid were injected subcutaneously on September 18 into each of 4 goats, 2 being affected with scours and greatly enfeebled, and 2 healthy animals, Nos. 1936 and 721. The first 2 died within forty-eight hours, as was expected, but the latter 2 are still healthy. The extent of immunity conferred by this filtrate was the subject of further consideration, and for this purpose goat No. 1936 alone was used. The animal was a young female Angora goat weighing 48 pounds, and received intravenously, on October 2, 1 c. c. of a bouillon culture prepared from the heart of a guinea pig that had died from a culture of goat spleen. At that time her temperature was 102.4° F. An elevation was noted on October 6, when 103.5° was recorded; on the 8th, 104°; and on the 10th, 105.2, at which time purging became established. On October 11 the animal refused food, was unwilling to stand, and was purging freely, the feces being very light in color and covered with mucus. October 12, still purging; feces nearly white; temperature, 104.2°. October 14, feces firmer, but still white; temperature, normal; weight 44 pounds; appetite improving; circulation of extremities impaired to such an extent that they feel cold to the touch; normal conditions quickly returned after

this time. After an interval of twenty-five days from the time of first injection another inoculation was made with 2 c. c. of a virulent culture intraabdominally, since this method has always shown more positive results. In this instance the goat became dull and languid, which conditions, however, quickly passed away, and her temperature never exceeded 102.4° F.

That the immunity was conferred by the 5 c. c. of filtrate received on September 18 must appear evident when taken in connection with the results obtained with the check animal, goat No. 1741 (see p. 370), which died eleven days after the inoculation with a similar culture. After one month had elapsed from the date of the complete recovery goat No. 1936 was bled aseptically, and the sterile serum procured for further experimentation. Five guinea pigs were inoculated, respectively, with 1, 1.5, 2, 2.5, and 3 c. c., and three days subsequently received 0.5, 0.25, 0.75, 0.50, and 0.30 c. c., respectively, of virulent culture, which killed the check guinea pig in eleven days after an intraabdominal injection. At the present time 3 of these guinea pigs show no inconvenience as a result of the inoculation, while the third and fifth guinea pigs, that received 0.75 and 0.30 c. c. of the culture, died on the forty-first and thirty-ninth day, respectively, the latter with takosis and the former of an intercurrent disease.

It will be seen at once that the immunizing properties of blood serum obtained from an immune goat were not perfect in their action when applied to the guinea pigs in this test, although the protection of 3 of the animals (Nos. 1, 2, and 4) offers sufficient encouragement to warrant further investigation along this line. Had the protective powers of the serum been theoretically effective, the guinea pig that died with takosis (the fifth of the test group) would have been the last one of the number to show the effects of the disease, as it received the largest amount of the serum and one of the smallest amounts of the virulent culture. Comparison of the duration of the affection in the case of the guinea pig that died of takosis thirty-nine days after the virulent culture was applied, with its course of only eleven days in the animal used as a check, indicated further that the serum exerted some retarding action upon the advance of the disease in this animal. This same serum has been subjected to a practical test on 20 goats in a flock of 250 in which the disease is now prevailing. The results of the above treatment can not be obtained in time for this publication. The test with blood serum as an immunizing agent against takosis is at present too incomplete to warrant any accurate estimate of its protective value, and, although the few experiments herein recorded show encouraging results, the immunity has not yet been proved sufficiently constant or reliable to justify at present a recommendation of serum for general use as a protective agent.

After observing the apparent bactericidal properties possessed by

the filtrate it was decided to ascertain the effect of the sterilized bouillon cultures. These were prepared by growing the culture for ten days in 5 per cent glycerinized peptone bouillon, then killing it by an exposure of thirty minutes to 60° C., and afterwards filtering through sterilized cotton. From this study it would appear that the toxins are extracellular and that they are destroyed by the above temperature, as the injection of this fluid failed to produce the least reaction in the inoculated guinea pigs; nor were the guinea pigs protected in the slightest degree from a subsequent inoculation of a pure culture, as will be seen from the following:

Six guinea pigs inoculated on November 7 with the sterilized cultures in doses ranging from 1 to 3 c. c. subsequently received, subcutaneously, 0.5 c. c. of a virulent culture simultaneously with two check animals. Deaths followed among the first group of animals in an average of sixteen days, while the two control animals died on the fourteenth and eighteenth days, respectively. Inoculation experiments were begun at the same time on a small flock of goats, each animal receiving 3 c. c. subcutaneously, which was repeated in ten days. The preliminary report in this instance confirms the work done on guinea pigs, and shows rather conclusively that the immunizing properties of sterilized cultures are practically nil.

MICROSCOPIC LESIONS.

Lungs.—Microscopically, the terminal bronchioles and alveolar passages present swollen walls and contain various amounts of mucous exudate and desquamated cells as a result of a catarrhal inflammation. In most cases where the diseased areas in the lungs of the goat were examined there has been found little pneumonic consolidation, but bronchiolitis is quite prominent. Some small areas of consolidation are seen with the alveoli and air sacs filled with granular débris and variable numbers of epithelial cells, red-blood corpuscles, and leucocytes. An active desquamation and proliferation of the epithelial lining membrane is present. The interalveolar septa show a considerable round-cell infiltration. The blood vessels of the septa are distended and surrounded by migrated leucocytes. Frequently a bronchus is found affected, with the lumen containing a small number of desquamated epithelial cells and slight fibrinous exudate and leucocytes. A round-cell infiltration is seen in the neighborhood of the bronchus, the walls of which are swollen, indurated, and granular in appearance. The surrounding peribronchial tissue shows in most cases an inflammation by contiguity. The pulmonary lesions observed in the guinea pig present the characteristics of a bronchopneumonia. The organism is occasionally found in the fibrinous exudate and in the blood vessels.

Liver.—In the liver of the guinea pig there appears to be a congestion of the blood vessels, especially in the portion lying beneath the capsule, and is accompanied by focal areas of fatty degeneration

occupying the peripheral zone of the acini in the form of numerous small globules, which in some cells completely obscure the nucleus. The protoplasm of the hepatic cells is extremely granular. In the organ obtained from the goat there is no congestion, but the areas of fatty degeneration are observable, although in a small degree and always in insular patches.

Kidneys.—The kidneys present the microscopic appearance usually observed in catarrhal or parenchymatous nephritis, with the most marked changes occurring in the cortex. Certain Malpighian tufts show an increase of cells due to the proliferation of the vascular epithelium, obscuring and compressing the capillaries. Increase of the cells of the tufts sometimes occurs. The intercapsular space is dilated and contains an albuminous exudate. The convoluted tubules show the epithelium to be swollen and granular, and in some cases desquamated, while the lumina of these tubules also show the presence of an albuminous deposit. As the micrococcus has not been found in the kidney on microscopic examination, the lesions here are presumably the result of the toxins.

Heart.—Localized areas of parenchymatous degeneration may be observed, involving isolated fibers or groups of fibers. Their contents are found to be fine granules of an albuminous nature, which do not completely obscure the striations or the nuclei of the muscle. In some fibers a more advanced stage has occurred, which results in the production of small, dark granules, accompanied with small droplets of fat. In the heart of the guinea pig the interfibrillar connective tissue shows a proliferation of the nuclei, and there is a slight indication of a round-cell infiltration.

Spleen.—A microscopical examination shows a thickened capsule, which is wrinkled and contracted. An increase in the thickness of the fibrous trabeculæ proceeding from the deeper layer of the capsule and from the walls of the small blood vessels is the conspicuous feature, with the accompanying atrophy of the Malpighian corpuscles and splenic pulp. The connective tissue cells and delicate strands of fibrillated tissue are very noticeable among the lymphoid elements.

Small intestines.—The appearance of these tissues, especially of the duodenum, is that of a productive inflammation with exudation, associated with more or less necrosis of the mucosa. The mucous membrane of the small intestine shows extensive desquamation of the epithelial lining and at times a superficial or even complete necrosis of the glandular layer. The mucosa may also present a typical productive inflammation with exudation of a fibrinous character and small cell infiltration around the engorged blood vessels. The solitary follicles are hyperplastic. The serous coat is thickened and the blood vessels visibly distended. Scattered profusely throughout the exudate and within the blood vessels of the submucosa, as well as in the intact mucosa, are the specific micrococci.

BLOOD EXAMINATION.

The attention of one who is called to examine a goat suffering with takosis is at once attracted by the anemic, bloodless appearance of all the exposed membranes. So prominent is this symptom that efforts have been made to determine the effect of the disease upon the blood. The germ (*Micrococcus caprinus*) is readily recovered from the blood of the circulation in any part of the body of animals that have died as a result of the test inoculations or of the natural disease. It is found in the plasma, but never within the cells themselves. Ellenberger (Physiologie der Haussäugethiere) and R. Meade Smith (Physiology of Domestic Animals) give the number of red corpuscles in a cubic millimeter of normal goat blood as varying from 9,000,000 to 10,000,000. A count was made from the blood of several goats obtained for experimental purposes in the laboratory and the result was confirmatory of this statement in a very satisfactory degree. The average result of the count in these cases gave the number as 9,976,000 per cubic millimeter and about 9,200 leucocytes in the same amount of blood. Later a count was made from the blood of an Angora goat sent to the laboratory during the last stages of the disease.

The animal was greatly emaciated, of an anemic, debilitated appearance, and was suffering from profuse diarrhea. We have no means of knowing how long this goat had been affected by the disease, but evidently it had been ailing for some weeks. The count of red corpuscles in this instance gave 11,208,000, showing a material increase above the normal number. Other counts were made from the blood of two Angora goats that had been received at the laboratory in a healthy condition and afterwards inoculated with *Micrococcus caprinus*, one receiving 1.5 c. c. of a bouillon culture intravenously and the other 1 c. c. intraabdominally. Violent purging ensued in eight days in both cases. The count of the corpuscles of the blood was made before the animals recovered fully from the effects of their inoculation and when the purging was quite profuse. The result obtained by counting the corpuscles under these conditions was that the blood in the first contained 11,190,000 red-blood cells and 20,560 white cells per cubic millimeter, while in the second case the red and white cells numbered 12,160,000 and 18,420, respectively. The leucocytosis in these instances was chiefly due to an increase in the number of polymorphonuclear leucocytes and the eosinophiles. In another case, affected with the natural disease, the red corpuscles numbered 10,208,000 and the white corpuscles 14,860.

It will be seen from the few blood counts thus far made that the number of red corpuscles is not diminished; in fact, it is sometimes increased (polycythemia), especially during the presence of the diarrhea, and is probably only relative, coincident with the removal of the watery constituents of the blood. The individual red cells are small

(normal size 4.1 μ.—Ellenberger), pale, and light in weight, presumably the result of the loss of nitrogenous material. They are also changed in outline, particularly in the later stages of the disease, when they assume an irregular, misshapen form (poikilocytosis). The increase in the number of leucocytes (leucocytosis) is absolute and dependent upon the chronic nature of this infection. In explaining the phenomenon in this instance we are inclined to ignore the overproduction theory of Virchow and Ehrlich and accept the idea advanced by Von Limbeck, Jakob, and Goldschneider, who hold that the bacterial toxins circulating in the blood act in a chemotactic manner to attract into the blood stream leucocytes which were previously in the lymph channels and spleen, and that these white corpuscles added to those already in the blood produce the leucocytosis. The specific gravity of the blood was taken in a number of instances with the average record of 1.031. It is utterly impossible to determine the amount of hemoglobin present by means of the Von Fleischel instrument, as the greenish tint of the blood is not comparable to the red of the index glass. However, the amount of hemoglobin was relatively ascertained as 56 per cent by a modification from Schmaltz (Pathologie des Blutes und die Blutkrankheiten, Leipzig, 1896), considering the normal specific gravity of the blood of the goat as 1.042.

TECHNIQUE.

For the histological study of the pathological alterations, the tissues were fixed in either Graf's chrome-oxalic fluid, Zenker's fluid, or gradually ascending strengths of alcohol and hardened in dilute chloroform. They were then infiltrated and embedded in paraffin and cut in serial sections. In bringing out the pathological lesions various staining preparations were employed, including hematoxylin and eosin, Weigert's fibrin stain, Bismarck brown and eosin, Gram's method followed by eosin, alum-carmin, and carbol-fuchsin counterstained with methylene blue, the best and most distinct sections resulting from the first two mentioned agents.

DESCRIPTION OF PREVIOUS EPIZOOTICS OF ALLIED CHARACTER AMONG GOATS.

The first mention in foreign literature of any disease of goats simulating the one now under consideration seems to have been made by Pusch [12],[a] of Dresden. The disease appeared in the fall of 1894 among a number of goats recently brought from the Simmenthal of Switzerland for breeding purposes. Upon their arrival in Saxony they were sold to different breeders and in this way were scattered about in six neighboring towns and upon thirty various farms. Several days later a disease appeared simultaneously among the goats of

[a] These figures refer to bibliography at end of this article.

this importation in five of the six towns in which they had been received, and it quickly spread to the neighboring goats with which they had been placed.

The animals were purchased on October 8, and were unloaded from the cars and delivered to their several owners on October 12. Nothing was seen to be wrong with them at this time, but after a few days complaints began to reach the authorities which stated that the goats were affected with cough and diarrhea. They were visited by Dr. Pusch on October 25, thirteen days after their arrival from the south. On the first farm which he visited he found three imported goats and one native goat sick. All of them coughed in response to percussion with a short, superficial, painful cough. The native goat seemed to be more seriously affected than those recently arrived from Switzerland. Its temperature was 40.5° C., respiration 35, and pulse 110; mucous membranes yellowish; nostrils widely distended; breathing labored and painful; appetite poor. The animal was so sluggish that she refused to stand. On another farm he found that one of the goats had been killed and its viscera buried. The heart and lungs were recovered and examined, but under the existing circumstances the results were not satisfactory. The heart was seen to be gray-red and very poor in fat. Pneumonia was present, accompanied with enteritis. Mice inoculated from these lungs gave negative results. On this farm the disease spread among the native goats to a serious extent. The incubation period was about ten days. Sheep kept in the same pasture were not affected. The greater part of the imported goats sickened after their arrival, and, as they were all bought in the Simmenthal and were not unloaded en route, infection during transportation was impossible. The disease appeared simultaneously among most of the goats of this importation, and quickly spread to the natives with which they had been herded, causing great loss among the latter animals.

The infected farms were quarantined until the diseased animals had either died or recovered, which required but a few months, as the affection disappeared voluntarily during that time.

Another outbreak of a very similar disease among goats was reported by Storch [14].

The native goats of Schmalkalden are of large size, rugged, good producers of milk, and, until the importation of Saanen goats from Switzerland, they were very healthy.

Twenty Saanen goats were imported and placed among the native flocks in May, 1894. In July the disease had become so widely spread that the authorities sent Schutz and Storch to investigate. Storch states that the report of Pusch, 1894, is the only one in German literature describing a disease which resembles this in any way, while Hutcheon's pleuro-pneumonia of goats in South Africa may be the same thing, but he is unwilling to decide.

Of 620 goats in Steinbach-Hallenburg 331 became affected, and

many of these died, but no accurate statement of the number of deaths was obtainable. In the acute form the goats refuse food, become dull and depressed, and lie down most of the time. Their breathing becomes labored and painful; pulse often reaches 120 to 140 per minute; cough is always present. About one-half of these cases are fatal, many of the animals dying in convulsions and opisthotonos.

In the chronic form a cough is always present, frequently accompanied by nasal discharge. The disease is lingering and persistent, but apparently does not affect the appetite.

Examination of the lungs showed collapsed areas in one or both anterior lobes. Mucous membranes of the bronchi were reddened, thickened, and covered by a slimy coating. Bacteriological examination revealed the presence in the lungs of numerous oval to round bacteria, frequently in pairs, but occasionally single, while the blood, spleen, and liver proved negative. White mice inoculated subcutaneously with cultures showed a staring coat and dullness, but recovered. A rabbit two months old inoculated with scrapings from a diseased lung died atypically in three days. Hepatized areas had developed in its lungs, however, and the presence of the organism in these tissues was established.

Healthy goats placed in isolated stalls in stables sheltering diseased animals became infected.

Susceptibility appeared to increase with age, since young kids were not affected. Mortality of the acute and chronic forms considered together reached about 25 per cent.

Careful inquiry failed to give any trace of a similar disease in the Simmenthal, where these goats were purchased. Further importations of goats into the Kingdom of Saxony were prohibited at once as a result of this outbreak.

Various experiments were made in the matter of treatment, but the best results were derived from the inhalation of creolin.

Nicole and Refik Bey [10], of Constantinople, describe a pneumonia among the goats of the region adjacent to the Gulf of Ismid, it having been brought there by goats purchased in the interior of the country.

The symptoms were first fever, then loss of appetite, cough, and nasal discharge, disturbed breathing, and soon the animal began to lag behind the flock, appearing dull and languid. The disease lasts a long time, and the animals become somewhat paralyzed four or five days before death. The attack is not commonly accompanied by enteritis. Calves and sheep kept in the same flock were not affected. Microscopic examination showed red and gray hepatization and the vessels filled with leucocytes. The pleura was thickened, and exudation into the pleural cavity was moderately abundant.

They have constantly isolated a cocco-bacillus from the lungs. It is sometimes alone and sometimes in association with the colon bacil-

lus or with *Bacillus pyocyaneus.* It was never found in the blood. It seems both by its form and character to belong to the hemorrhagic septicemia group. The bacillus does not retain its stain when treated by Gram's method. On liquid media it appears sometimes as a diplococcus, and again as a lance-shaped bacillus, resembling in its contour and size the pneumococcus of Talamon-Fraenkel. When the nutriment in the media is abundant, its form is round and there is a decided tendency to form chains. Mice were most susceptible to this germ. A very small quantity of culture injected subcutaneously caused death in ten to twelve hours from septicemia. Two cubic centimeters subcutaneously kills rabbits in eight days, forming abscesses in the lungs. A test goat died in four weeks, emaciated, and with limbs paralyzed during the last few days of life. Cocco-bacilli were recovered from all visceral organs. Another goat recovered. A third goat showed diarrhea and fever the day after being inoculated and then recovered. It was subsequently reinoculated with fluid from a hepatized lung and died in one month. All goats tested in the laboratory proved very resistant. Calves and dogs were inoculated with 5 c. c. of a pure culture without results.

The men who were first interested in introducing well-bred Angora, Tibet, and Cashmere goats into this country encountered some thoroughly discouraging experiences, which were very probably due in a measure to the ravages of the disease under consideration. As early as the year 1854 a prospective purchaser of Tibet goats living in the State of Georgia was warned by a naturalist of note against completing his purchase for the reason that these goats, "like the llamas of the Andes, could not be successfully acclimated in a locality under 10,000 feet above the ocean." The purchase was consummated in spite of the friendly warning of the naturalist, and the final owner[2], in recounting his experiences later, wrote: "His opinion proved to be correct, as all of the Tibet goats, pure and grades, in my flock died in a few years after I had purchased them, from a disease of their lungs combined with dysentery."

A writer[1] in the Country Gentlemen of February 4, 1875, also reports serious losses in a flock placed in his care on a farm at Rapidan, Va. Although he records no specific symptoms, the following quotations have great interest to all who are making a study of takosis:

> In the early cold weather the goats began to sicken. I had the sick ones removed to other quarters, and wrote for remedies to Mr. E. I studied Randall also, but nothing cured them. They died, and more were taken sick. I sent for Mr. E., the owner of the goats, and when he came he said the difficulty was cold and hunger, though they had more than a "little hay and fodder" besides additional meal, much more in proportion than my sheep, which at that time were running at large without shelter and doing well. * * * The next morning a fine young buck which had been apparently well the night before was brought out in a dying condition. Mr. E. examined it closely and said it was a decided

case of liver disease, an infectious epidemic which Angora goats were subject to in their own country, and regarded as so fatal by the Turkish shepherds that they said of it, "There is no cure but Allah."

Pegler[11] in the year 1885 described what he termed "A disease peculiar to goats." It will be seen upon reading the following excerpt from his work that his description of the scourge that appeared among the members of his flock might, in most particulars, very well be applied to a flock affected with takosis. From the page describing symptoms were borrowed the following:

The first thing that is noticed is a falling off of appetite, which may at first be slight, but soon gets worse until it is a difficult matter to get the animal to eat at all. The result, of course, is that it rapidly loses flesh and falls away to a skeleton. Sometimes, however, the appetite remains good, but the emaciation goes on just the same, though the process is slower. The breathing is sometimes labored and the breath nearly always very unpleasant. A cough is very often an accompaniment of the disease, leading one to suppose, with other symptoms, that the lungs were affected, but this is seldom the case. The one prevailing feature which can never be overlooked is the general bloodlessness of the animal. This is shown by the pale color of the gums and inner surface of the lips, and also of the membranes lining the eyelids, which in health are of a bright red.

Before the disease is far advanced diarrhea sets in, which begins with a slackness of the bowels. This soon gets worse, however, and, though it may be stopped for a time, it is almost sure to break out again, owing to the failure of the digestive organs from the impoverished condition of the animal. The diarrhea may last for several weeks, but as it advances it often takes the form of dysentery. The poor creature then becomes too weak to stand, and it generally dies uttering plaintive cries and moans. There are other symptoms which occasionally manifest themselves, such as swelling beneath the jaws and weakness about the limbs, the animal always standing with its head down and back arched, looking the picture of misery and dejection.

Strange to say, in nearly all the postmortems which have been made and reported to me, there has been no organic disease. Internal parasites are sometimes discovered, but not in sufficient quantities to greatly affect the animal's health, much less cause its death, which in all cases is due to exhaustion.

ECONOMIC IMPORTANCE.

A few years ago the flocks of Angora goats in this country were comparatively unimportant in number, and they were nearly all of them kept in Southern latitudes, but during recent years the raising of these animals has received a remarkable impetus. New uses have been discovered for the fleece, they have been widely exploited as brush eradicators, and their flesh has been more readily accepted as a food product, until at present they have reached an established, settled value in many of the larger live-stock markets. As a result of the widespread interest thus awakened in them, many stock raisers have made purchases of foundation stock with the intention of establishing therewith a profitable flock. Others have made larger purchases at the start, being unwilling to wait for the slow natural increase in numbers of their animals. By means of numerous transactions the animals have been placed in widely distributed Northern localities to

which they were formerly strangers, but the serious losses caused to these investors by outbreaks of takosis served as a check to many prospective purchasers, and the Angora goat industry was, in consequence, subjected to a discouraging setback, and has not expanded to the proportions which it would otherwise have reached.

Now that the cause of the trouble has been determined, one may be warranted in claiming that the disastrous effects of all outbreaks up to the present time may in the future be avoided in large measure. The owner of the flock of goats will now see the importance of deciding upon the nature of the ailment affecting them just as soon as any general disease is noticed; and when takosis has appeared and been identified, if he will at once apply the precautionary measures and the course of treatment to be recommended later in this work, he should avoid many of the discouraging experiences of his predecessors.

As has already been stated in this article, the most serious losses that have come to our notice have occurred among goats that were removed from southern localities to new regions far to the northward, and that had not become fully acclimated in their new surroundings. In many instances the trouble has appeared very soon after the arrival of the animals at their destination, even before they have recovered fully from the serious strain incident to the long journey by rail.

There is always a value to be derived from the confirmatory statements of many witnesses. Various observers are sure to offer a variety of observations upon any subject in which they may have a common interest, and for the purpose of presenting to the reader as generalized a knowledge as possible of the effects of takosis upon a flock of goats, and also for showing how diversified is the territory in which the ravages of the disease are being felt, it has been deemed advisable to present the following extracts received by this Bureau with reference to the disease.

From Knapp, Wis., the following was received:

I have in my charge about 500 goats, and they have been dying from what I called stomach worms; but of late I have come to the conclusion that something else is the matter with them. They lose their appetite, grow thin in flesh, cough, and get weak, and then lie down and die. Some linger along two or three months. There is from 1 to 5 in the flock that show the symptoms all the time, and from 1 to 2 die per week. They first cough, then lag behind the flock at night when coming to the barn. Then there is lack of appetite, they grow poor and weak and look gaunt all the time, as though they have been starved.

A letter of inquiry from Pittsburg, Pa., asks:

Would some of you let me know what the proper feed is for goats through the winter when they have no pasture? I bought a few Angora goats and so did a few of my neighbors, and they are dying. The flock that we obtained them from was very poor, in fact I never saw anything poorer to live than the goats were when we received them. I feed mine on corn and oat chop, half and half, and corn fodder, and cut some apple brush, but for all I could do my goats died with scours.

A writer from Langhorne, Pa., sends the following record of his observations:

To look at our goats in the yard you would say they looked fine, and you could hardly pick out one that you might think was not quite up to the average, yet to-morrow morning you would find four or five down on their sides or otherwise. If picked up they might move off slowly and eat a little, but the next morning they would be down again. The animals will not get up or stay up, but will linger in this manner for some days, smelling badly and bleating occasionally or groaning, with head bent around on side or under them, and finally die. Sometimes, as a result of lying so long, they get apparently choleraic discharges from the bowels, which is offensive; but this does not show at first and is not the primal cause.

Tioga County, Pa., has for several years had a flock of Angora goats, representing among its members some excellent specimens of the breed. The owner of this flock, in describing the course of takosis, writes:

None of the diseased goats recovered. It took a long time for many of them to die. They tried very hard to live, and some of them succeeded in living for weeks, only getting weaker and weaker and finally just fading away. Some had diarrhea, but many did not.

In making a report of postmortem findings, a correspondent from Iowa mentions one of the characteristic symptoms of takosis as follows:

The amount of bile is from one-fourth to three-fourths of a pint in each goat. A healthy goat only has, as I find, about a tablespoonful. This goat has been ailing for two weeks, but only refused to eat for two days. I have lost one-third of my flock and have not been able to save even one goat that has become sick.

A breeder in western Illinois states that he has lost 100 out of a flock of 400, and that two of his neighbors have suffered proportionate losses. These goats were all well sheltered. He considers the disease some sort of cholera, reasoning from the fact that the animals were all affected with diarrhea.

The following extracts, from a letter received just as this paper was ready for the press, from the owner of a large flock of Angora goats in Michigan, confirm several of the statements made in the introduction of this article:

We personally suffered a loss last winter in animals that we had brought from Texas in November, 1901, from this disease, and thus learned of the trouble. * * *

We gathered together a herd of all grades of goats for the purpose of studying them, and finally arrived at the conclusion that, so far the Angora goat is concerned, the animal most susceptible to the disease was the result of careless breeding, or, to be more exact, too much inbreeding, thus lowering its vitality and leaving it open to the attack. * * *

The care, feed, and shelter of the various grades of animals we have had was all alike, and it resulted, as stated, in the survival of the carefully bred, free-from-inbreeding Angora goat.

Other reports of like nature have been received from goat owners in Oregon, Missouri, Massachusetts, Virginia, and Maryland, all describing the affection as an incurable weakening and wasting away,

usually accompanied by uncontrollable diarrhea and occasional cough. The death rate has been very high in the flocks from which reports have been obtained and ranges from 30 to 85 per cent.

Another feature of takosis, which is of great economic importance to the breeder of goats, is experienced in the unavoidable tendency to abortion which is manifested by all pregnant females that are affected with the disease. Females of the sheep and goat families will never reproduce in a prolific manner if in a wasted, emaciated condition during the breeding season. Many of them will fail to come in heat, and others, though passing through the period of estrum normally, will fail to conceive. Takosis is essentially a wasting disease, and one of the marked results of its attack upon a flock of breeding goats is seen in the shrunken kid crop of the following season.

It is rare indeed for a pregnant doe to complete her term of gestation if attacked during this period by takosis. Abortion follows almost invariably. As might naturally be expected, the accident of abortion under these circumstances always ends fatally, as the animal is unable, in her already weakened condition, to withstand the shock incident to delivery. Many times the fetus dies in utero, and thus becoming a foreign body to the maternal organism, it but hastens the eventual collapse of the doe. In holding autopsies on the bodies of affected pregnant does, it has been occasionally noted that the death of the fetus preceded that of the mother by a few days, and the fetal decomposition present has indicated that it played a prominent part in causing the death of the adult.

One flock has been brought to our notice which contained about 1,600 does at the commencement of the breeding season in the fall of 1901. They were seriously affected with takosis at this time, and in consequence there were but 17 living kids produced in the following spring.

Another instance is reported where the total increase of a flock of over 1,000 does for the year was limited to 11 living kids.

DIFFERENTIAL DIAGNOSIS.

PARASITISM.

The condition which will most frequently be mistaken for takosis in goats is parasitism. In common with sheep, goats serve as hosts for a formidable array of animal parasites, and the loss directly or indirectly due to parasitic invasions must annually serve as a serious tax upon the goat raisers of the country.

The effects of internal parasites upon the goats are very similar in many of their outward manifestations to the symptoms of takosis. There is a persistent unthriftiness, although the appetite of the animal remains good. The fleece does not retain its proper luster. There may be considerable snuffling of the nose, accompanied by frequent coughing. The animal may become affected with diarrhea, more or

less severe, and its accompanying weakness. The eyes lose their brilliance and gradually assume a dull sunken appearance. The formation of an edematous tumor beneath the jaws is frequently noticed during the later stages of a serious invasion. These, in a general way, are the symptoms resulting from an attack by animal parasites, but it must be remembered that there are species of worms that find their natural habitat in some particular organ, and that, in consequence, it is impossible to give an accurate enumeration of the symptoms that may be manifested in any given case under the general heading of parasitism.

The symptoms produced by the local disturbance of the affected part will predominate, while others, frequently caused by parasitic invasion, will be entirely lacking. Careful postmortem examination will quickly disclose the presence of parasites. A differential diagnosis previous to death of the animal may, however, be made by giving due consideration to the various symptoms manifested by these diseases. First of all, the infectious nature of takosis, when compared with the enzootic course of a parasitic invasion, will justify one in making a definite diagnosis. In attacks of takosis, symptoms of pneumonia will be frequently noted, especially labored breathing or rapid respiration. These symptoms are not diagnostic of parasitism. The edematous lump under the jaw, so frequently present in cases of parasitism, fails in takosis. The luster of the fleece is less affected in takosis, while diarrhea is more frequently noted. Continuous coughing and snuffling, while diagnostic of the presence of lungworms, are not characteristic of takosis and are noted only occasionally in cases of this disease, unless there is a complication with some other affection.

ANEMIA.

In goats this is very rare, and when it does occur it is usually secondary to some previously existing disease, such as chronic pneumonia, peritonitis, or to poor food and starvation. It does not assume an infectious nature, and may be differentiated from the anemic condition accompanying takosis by the absence of the specific organism on microscopic examination.

WATERY CACHEXIA, OR HYDREMIA.

This usually results from poor feeding, innutritious food, or pasturing on low ground. The natural goat pasture is high, dry land. The animal is weak, readily exhausted, breathes rapidly, and its heart palpitates. The mucous membranes of the eyes, nose, and mouth are pale and swollen. The edema which is present about the head, neck, and abdomen will serve to differentiate this disease from takosis. This edema of the head disappears when the animal lies down. Icterus may accompany the disease when the discoloration of the mucous membrane easily establishes the nature of the affection. A change of pasture

and a more nutritious diet are accompanied by a return of health to the flock.

CONTAGIOUS PNEUMONIA.

There have been several instances recorded in which flocks of goats have been affected with a contagious pneumonia.

Hutcheon [6] has met with this epidemic in South Africa; Steel [13] has seen it in East India; and it has also been brought to the attention of French, [3, 8] and Italian [9] veterinarians.

Soon after the outbreak of this disease in the flock many of the animals will become affected with a cough. The temperature rapidly rises until occasionally as high as 107° F. is recorded. The appetite becomes disturbed or disappears altogether, and there is slight nasal discharge. The conjunctiva appears brownish or bronzed, the vesicular murmur of the lungs becomes modified, the pulse quickened, and the breathing accelerated, labored, and painful. The affected animals always evince pain when pressure is applied between their ribs.

The postmortem examination of these cases shows the lesions to be chiefly confined to the thoracic cavity. The visceral pleura is usually adherent to the thoracic walls. The diseased lung is solidified and enlarged throughout one-half to three-fourths of its substance. It is covered with a firm, elastic, fibrinous membrane.

Respecting the nature of the disease, Dr. Hutcheon writes:

> It was a specific infectious form of pleuro-pneumonia, affecting goats only, cattle and sheep remaining free from infection, although constantly exposed to it. The disease was introduced into the Cape Colony by a shipment of Angora goats from Asia Minor, where the disease is represented as being indigenous.

At the present time contagious bovine pleuro-pneumonia has no existence among the flocks or herds of America, but since the goats of other countries have been proved susceptible to an analogous disease, the above mention of its leading characteristics may not be out of place.

TREATMENT.

PROPHYLAXIS.

In the study of takosis four points have been brought prominently into view which may properly be grouped together when considering measures for the prevention of the disease. It has been shown that the most destructive outbreaks have occurred among the goats that just previously have been shipped from a southern locality to a more northern latitude, and this fact suggests the need of caution in the removal of animals in this direction. Sudden climatic changes should be avoided so far as possible, and when shipments of goats for breeding purposes are to be made which necessitate their transportation northward over considerable distances the changes should be made during the months of summer or late spring, and not in the fall or winter, when the contrast of temperature will be so much greater.

Earlier writers have called attention to the fact that Angora goats do not take kindly to transportation from one climate to another. Hobson[4] states that the native proprietors of Angora flocks in Asia Minor unanimously assert that this goat can not be transported from the place where it was born to a neighboring village of a different altitude without suffering a deterioration, and although able to resist both heat and cold they can not withstand much humidity, either in their pastures or folds.

The second precautionary measure is closely allied to the first, namely, Angora goats should be provided with stables that are thoroughly dry, not alone in their ability to shed rain, but on acount of being erected upon ground that has perfect natural drainage, and these should be accessible to them at all times, as the effect of rains upon the general health and strength of these animals has been frequently proved to be very disastrous. So great is their natural aversion to a wetting that they will seldom get caught out in a shower if shelter is within their reach, but will leave their browsing and march under cover before the downpour arrives. The reason for this is obvious. Their fleece is wholly lacking in yolk; consequently it will not shed water in the least, and a fall of rain immediately soaks the animal clear to the skin.

As a third measure of prevention may be mentioned careful feeding. No animal is as well fortified against the attack of an infection when reduced by lack of nourishment as it is when in vigorous, thriving condition. Among the predisposing causes of disease usually enumerated by general pathologists will be found debility due to insufficient or unsuitable food, and, although the reason for this may not be established beyond the reach of argument, it is pretty generally conceded that the continued lack of proper nourishment establishes in the blood of an animal an abnormal degree of alkalinity which grants an increased susceptibility to the inroads of pathogenic organisms.

Another preventive measure to be mentioned here is one that is applicable only after the disease has made its appearance in the flock. The segregation or isolation of all affected animals as soon as they evince any symptoms of the disease will be found a most valuable means of protection for those that remain unaffected, and a strict quarantine over all of the diseased members of the flock should be maintained so long as the disease remains upon the premises.

In our previous experiments for the purpose of procuring an immunizing agent against this disease the results were such as to warrant a practical application of the sterile filtrate previously described (page 373) to several flocks of goats generously placed at our disposal. The fluid thus prepared has been injected into the skin over the shoulder of goats in doses of 3 c. c., with varying results. One flock, originally consisting of 82 animals, had been decimated by takosis until it numbered but 32. These animals received two

inoculations ten days apart, and immediately after the last injection they were transported in wagons late in November to a point thirty-eight miles away. On account of the condition of the roads the trip required about two days. During this time the goats were without food or drink and were not unloaded. Two of them died, one on its arrival at the farm and the other not till three days later, although it was scouring badly upon reaching its destination. The remainder of the band seem in a healthy condition and are the most sturdy of the flock of six hundred to which they have been added. At a later test of this filtrate, made in one of the Western States, upon a flock of goats, the effect of treatment was most unsatisfactory. The goats were inoculated twice with the remedy with an interval of ten days. Recent letters from the owner state that there is no improvement in the condition of the flock, but that the fatalities continue to occur with the usual frequency. He has since been advised to make use of the medicinal treatment mentioned below. From another Western breeder a most flattering report has been received. He states that after the use of the prophylactic treatment the disease disappeared from the premises, and up to the time of writing all of the animals on the place had remained in a thriving condition.

THERAPEUTICS.

Medicinal treatment has proved unsatisfactory in many of the cases of takosis to which it has been applied. Previous to the study of the disease the treatment was directed against the pneumonia, and for a short time marked improvement followed; but it was merely coincidental, as deaths occurred later with the usual regularity. Then intestinal disinfectants and astringents were suggested, but these did not prove efficacious. The most pleasing results that have been derived from the use of drugs in our experiments at the laboratory have followed the administration of calomel given alone in 0.1-gram doses twice daily for two days, to be followed by powders composed of arsenic, iron, and quinine, as follows:

	Grams.
Arsenious acid	1.40
Iron, reduced	12.00
Quinine sulphate	6.00

Mix and make into twenty powders, giving one to each adult goat morning and evening at the conclusion of the administration of calomel. After an interval of two days this treatment is repeated. In case the diarrhea persists, the sulphate of iron has been substituted for the reduced iron, with beneficial effects.

CONCLUSIONS.

As a result of the present preliminary investigation, the following conclusions have been reached:

1. The disease here described as takosis has appeared in many parts

of this country, but particularly in the Northern States, where it has caused great loss to many breeders of Angora goats.

2. It is a progressive, debilitative, contagious disease, characterized by great emaciation and weakness, with symptoms of diarrhea and pneumonia, and causes a mortality of 100 per cent of those affected and from 30 to 85 per cent of the whole flock.

3. From the carcasses of numerous animals that have succumbed to this disease a new organism, *Micrococcus caprinus*, has been recovered in purity and is presumably the etiological factor.

4. This micrococcus possesses pathogenic properties for goats, chickens, rabbits, guinea pigs, and white mice, but not for sheep, dogs, or rats.

5. Although the disease has been described before [11], so far as could be ascertained no bacteriological investigations have been previously made.

6. Medicinal treatment was attempted with varying success, while the immunizing experiments thus far conducted (although too few to permit of any conclusive statement or accurate estimate as to their protective value) have shown highly encouraging results. When accompanied with measures of isolation and disinfection, the treatment may prove of great assistance in the suppression and eradication of the disease in an infected flock.

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FOOT-AND-MOUTH DISEASE.[a]

By D. E. SALMON, D. V. M.,
Chief of the Bureau of Animal Industry.

DISCOVERY OF LATEST OUTBREAK IN UNITED STATES.

An unexpected outbreak of foot-and-mouth disease was discovered in Massachusetts and Rhode Island in November, 1902. The Department of Agriculture first received an intimation of the existence of this disease on November 14, 1902, in a letter from Dr. Austin Peters, chief of the cattle bureau of Massachusetts. This letter stated that a disease resembling foot-and-mouth disease had been discovered in Rhode Island, and that an investigation would be immediately made and the results reported. On November 17, Dr. Peters telegraphed that he believed the malady to be foot-and-mouth disease. Immediately upon receipt of this telegram, Dr. John R. Mohler, chief of the pathological division of the Bureau of Animal Industry, was sent to Massachusetts to investigate and report upon the disease existing in that section of the United States. Dr. Mohler reported in a letter received November 24 that the disease was probably the European foot-and-mouth disease, and gave sufficient details as to symptoms and nature to allow an intelligent opinion to be formed. A calf and two sheep which he inoculated contracted the disease within two, four, and five days, respectively.

MEASURES TO PREVENT SPREAD OF THE DISEASE.

As there was no history of the introduction of affected animals into the United States, and a declaration of the existence of the disease would have such serious consequences in commercial restrictions, it was deemed advisable to have additional expert opinions. Dr. Leonard Pearson, dean of the veterinary department of the University of Pennsylvania, and Prof. James Law, dean of the New York State Veterinary College, were at once asked to proceed to Massachusetts and give an opinion as to the nature of the disease. Their joint report pronouncing the malady to be foot-and-mouth disease beyond doubt was received November 27, and the quarantine order on the next page was promulgated the same day.

[a] In order to present a continuous report of this outbreak, the data have been brought down to June 1, 1903.

QUARANTINE OF CATTLE, SHEEP, AND OTHER RUMINANTS, AND SWINE, IN THE NEW ENGLAND STATES.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., November 27, 1902.

To the managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In accordance with section 7 of the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pluero-pneumonia and other contagious diseases among domestic animals," and the act of Congress approved June 3, 1902, making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1903, you are hereby notified that the contagious disease known as foot-and-mouth disease exists among animals in the States of Connecticut, Rhode Island, Massachusetts, and Vermont, and that the cattle, sheep, and other ruminants, and swine of said States have been exposed to the contagion of said disease: Therefore,

It is hereby ordered, That, to prevent the spread of the said disease from the States of Connecticut, Rhode Island, Massachusetts, and Vermont into other States or foreign countries, and to aid in its eradication, no cattle, sheep, or other ruminants, or swine, shall be moved or be permitted to move from or across the territory of any one of the States above named into any other State or foreign country. Any person, company, or corporation violating this order will be proceeded against as provided for by the act of Congress above referred to.

It is hoped that all transportation companies, cattle shippers, and others interested in the welfare of our animal industry will cooperate with the Department of Agriculture in enforcing this order, to the end that the restriction on traffic may have the desired effect and be removed in the shortest possible time.

JAMES WILSON, *Secretary.*

An order was also issued prohibiting the exportation of animals from the port of Boston, as follows:

PROHIBITION OF THE EXPORTATION OF CATTLE, SHEEP, AND OTHER RUMINANTS, AND SWINE, FROM THE PORT OF BOSTON.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., November 27, 1902.

Whereas a highly contagious disease, known as foot-and-mouth disease, exists among cattle in the State of Massachusetts, and the routes of transportation possibly may have been contaminated, and, in order to protect the export trade in live animals by preventing the exportation of animals which are diseased or which have been exposed to disease,

It is hereby ordered, That no cattle, sheep, or other ruminants or swine, shall be permitted to be exported from the port of Boston until further orders.

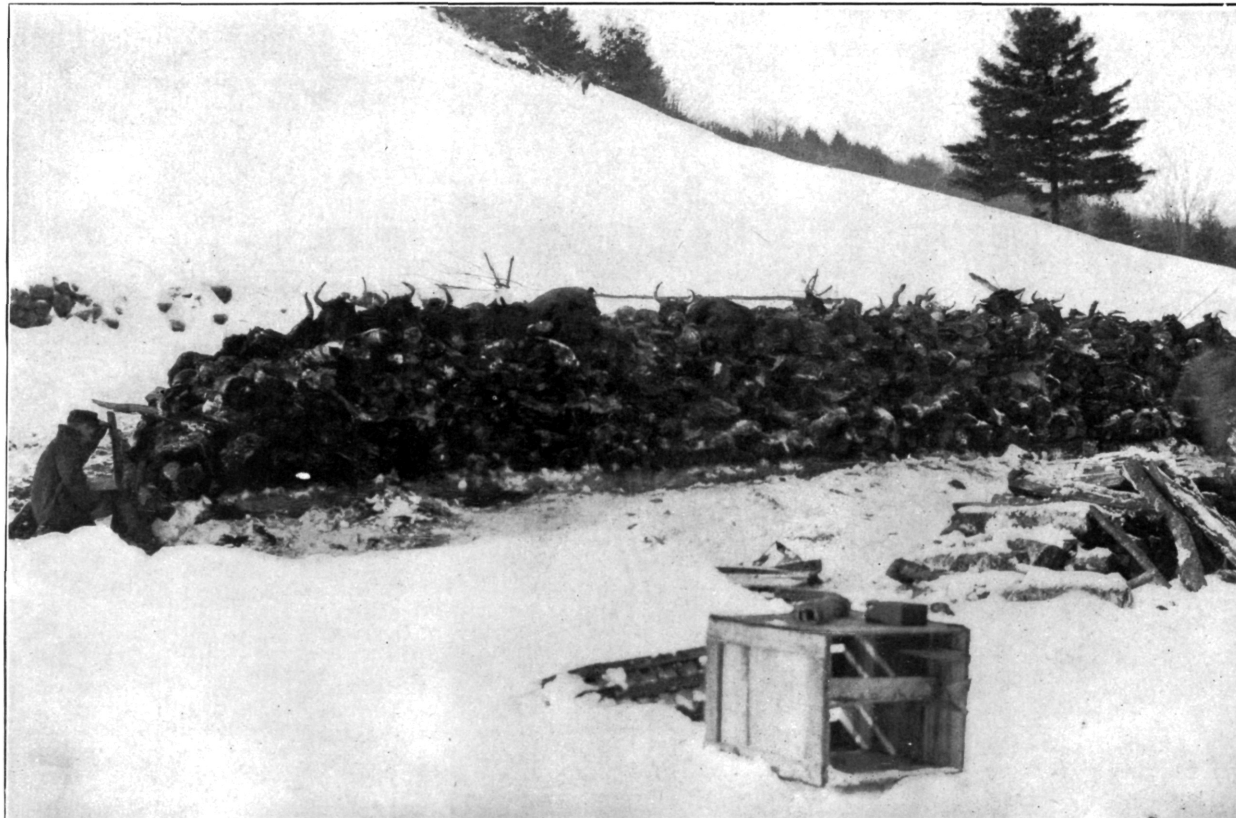
JAMES WILSON, *Secretary.*

On the 1st day of December the writer went to Massachusetts to supervise and direct the Federal work of eradicating the disease. In the meantime, a number of veterinarians in the service of the Bureau of Animal Industry in various parts of the country had been hurriedly summoned to Boston to supplement the local force. Dr. S. E. Bennett,

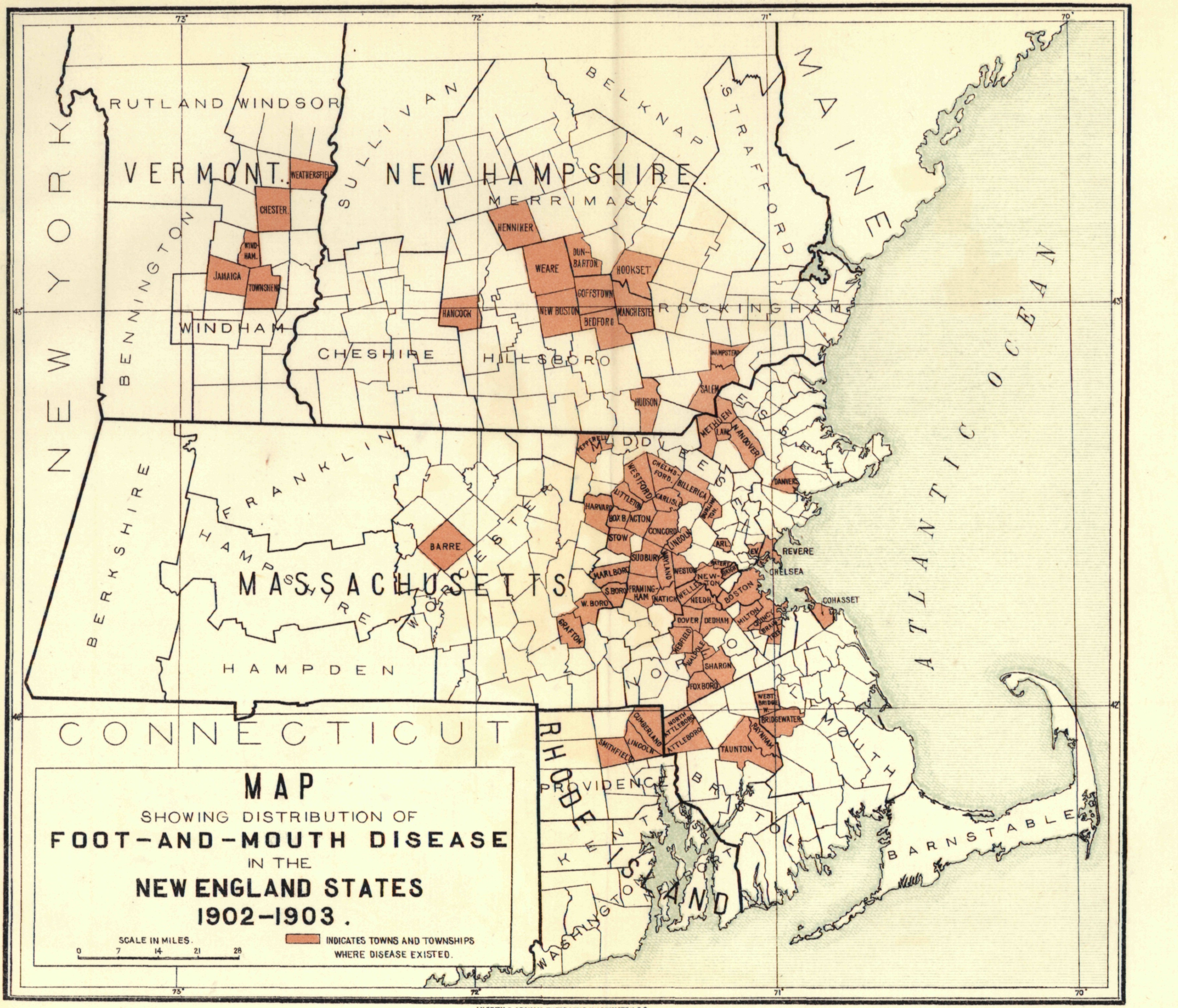
Burial of Carcasses of Cattle in Deep Trench.

BURIAL OF CARCASSES OF CATTLE.

CARCASSES OF CATTLE LYING IN TRENCH AND COVERED WITH LIME.



Carcasses of Cattle Piled with Wood Ready for Burning.



ANDREW B. GRAHAM, PHOTO-LITHO. WASHINGTON. D.C.

the Bureau's chief inspector at Boston, was placed in charge of the force. Dr. F. A. Rich, of Burlington, Vt., was specially engaged and put in charge of the work in Vermont.

DISTRIBUTION OF THE DISEASE AND MEASURES FOR ERADICATION.

It appeared that the disease had existed in Massachusetts since August, and had extended over the eastern part of that State and into Vermont, New Hampshire, and Rhode Island. At the time the Federal quarantine was declared the disease had not been discovered in Vermont, but its existence was strongly suspected. Investigation afterwards showed that a single center of contagion existed in that State, and that about 20 herds were affected. Four herds were subsequently found affected in New Hampshire, but as they were immediately slaughtered no general quarantine was placed upon that State at that time. Later, however, the disease was found to exist more extensively in New Hampshire, and on March 7, 1903, an order was issued quarantining that State. A careful investigation as to the condition of Connecticut failed to reveal any evidence of the disease, or anything to show that the contagion had existed there, and the quarantine on that State was therefore removed by an order dated December 22, 1902.

With such a comparatively wide distribution of the contagion at the time the disease was discovered, it was a serious problem to decide as to the best method of handling it in order to prevent the further dissemination of the disease, and to guard so far as possible against the danger of its spread to other States. It was also important to take measures to prevent the escape of the contagion from control and its spread over the whole of the United States. At the time the Federal quarantine was established and the work of repression begun, the disease was spreading very rapidly and new herds were daily becoming affected. The accompanying map shows the distribution of the disease from the beginning of the outbreak to June 1, 1903. In many instances there were several diseased herds in a single town or township.

After carefully considering the conditions which existed and the enormous loss with which the country was menaced by the spread of the contagion, it was decided to slaughter the diseased animals as soon as this could be done, and to thoroughly disinfect the buildings in which they had been sheltered. As a basis of compensation, an agreement was made with the governor of Massachusetts that the animals would be appraised at their value as if in good health, and that 70 per cent of this appraisement would be paid as compensation to the owners by the Federal Government.

Great difficulty was experienced in disposing of the carcasses in a satisfactory manner, especially during the extremely cold weather, when it was very hard to dig trenches on account of the depth to which the ground was frozen. An effort was made to burn the car-

casses, and this was successful in Vermont and at Barre, Mass. However, it was found that burning was a slow process where so many carcasses were to be handled and where fuel was more or less difficult to obtain. Accordingly, most of the carcasses were buried after the hides had been slashed and after they were covered with caustic lime. Plates XLVIII and XLIX show the manner in which the carcasses were disposed in the trench, and Plate L shows the same after they were covered with lime. Plate LI shows the carcasses piled up with wood ready for burning.

The disease was so easily carried from stable to stable by persons that it was necessary to take special precautions to prevent its spread by the inspectors who must necessarily visit the diseased herds and who must make investigations of suspected herds. To avoid this danger so far as possible, the inspectors were instructed to carry with them rubber caps, coats, and boots, which were to be worn while they were in the stables and sponged off with a disinfecting solution before they left the premises. Plate LII, fig. 1, shows an inspector attired in this manner who has just been sponged off with the disinfectant. In addition to this it was finally decided that the inspectors should also have rubber cloaks which would tie tightly around the neck and reach the ground, by the use of which the entire clothing might be disinfected in a few minutes by generating formalin with a suitable lamp placed under the cloak. Plate LII, fig. 2, shows this garment and the formalin lamp which were carried around by the persons engaged in this work. Plate LIV illustrates the manner in which laborers were disinfected under supervision of the inspectors.

THE DISEASE IN EUROPE AND PREVIOUS OUTBREAKS IN AMERICA.

Foot-and-mouth disease has appeared so seldom in the United States and the outbreaks have been so small that the great losses which it may cause are not appreciated in this country, simply because the people have not experienced an outbreak of sufficient magnitude to observe its effects. There has consequently been some surprise expressed that such a radical measure as slaughter was adopted, and there has been an effort to show that the disease is mild and causes only slight losses. The promulgation of such views, even though they were founded upon ignorance of the disease, had the effect of arousing a certain amount of opposition to the work, hindering its progress, and to a certain extent jeopardizing its success. As the contagion is is now in this country, it is well that the American farmers should understand the losses which are caused by foot-and-mouth disease and the measures which have been found necessary to control it in other countries. Most veterinary text-books state that foot-and-mouth disease is a mild affection, and that only 1 or 2 per cent of the animals attacked die from it, the reader being left to infer that the losses do not exceed 2 or 3 per cent of the value of the animals. Such a con clusion, howevei, would be a very grave mistake.

This disease has been known to the veterinarians and agriculturists of Europe since the time when, with advancing medical knowledge, it was possible to discriminate between the different plagues of animals. It has been more or less constantly present in the countries of Europe, and has been particularly prevalent on the Continent. Dr. A. C. Cope,[a] chief veterinary officer of the British Board of Agriculture, speaking in the year 1900 of its ravages in Great Britain, says:

> The disease was seen and recognized in 1839, and continued with more or less prevalence until 1886. It was reintroduced in 1892, and again appeared in the latter part of 1894. And now, after the lapse of an interval of nearly six years, the disease has again found its way into this country, despite the fact that the importation of animals from all countries in which foot-and-mouth disease was known to exist has been prohibited for a period of eight years.

In continental Europe the disease became seriously disseminated about 1886, and has continued its ravages until the present, notwithstanding the most stringent regulations which have been adopted.

There have been but a few outbreaks in America, the most extensive one being in 1870, when the contagion was introduced by way of Canada and spread into the New England States and into New York. The type of the disease at that time appears to have been mild, and the dissemination of the contagion was quite easily arrested. About 1880 there were two or three lots of animals brought to the United States affected with this disease, but there was no extension from the animals originally affected. In 1884 there was a small outbreak at Portland, Me., caused by imported cattle, and the disease spread to a few herds outside of the quarantine station. Owing to the small number of animals affected and the limited area of territory covered by the disease, it was easily controlled by the ordinary measures of quarantine and disinfection.

RECENT INTRODUCTION OF THE DISEASE INTO THE UNITED STATES.

It is not definitely known how the contagion was introduced into the United States in 1902, but the first herds affected were in Chelsea, Mass., in the vicinity of the docks, to which place the infection was no doubt carried from shipping. There are numerous channels by which it could have been introduced from Europe, where it has been very prevalent during the last fifteen or twenty years. Horses are continually being imported with halters, ropes, forage, and bedding; small animals, such as goats, are often upon the ships, and fresh hides are also a constant article of commerce, and may come without sufficient disinfection from countries in which the disease exists. There are also imported large quantities of hair, wool, and other articles which might bring the contagion. As all cattle, sheep, and swine

[a] Annual Report of Proceedings under Diseases of Animals Acts, etc., for 1900. London, 1901. P. 4.

imported from European countries are placed in quarantine from fifteen to ninety days, it is impossible that the disease could have been brought with these animals without being recognized before they left the quarantine station.

STUDY OF THE DISEASE AND LOSSES BY IT IN EUROPE.

During the many years that the disease has been known in Europe there has been abundant opportunity to study its characters and to become familiar with the losses which it causes, and it may be fairly said that this disease is now dreaded more than any other which affects the farmers' live stock. Even in the mildest outbreaks, when but 1 or 2 per cent of the grown animals die from it, there are numerous other sources of loss which are much more important than the actual mortality. The fever and the difficulty of masticating the food cause a rapid and extreme loss in flesh and the cessation of the milk secretion. The udders often become inflamed and ruined by the formation of abscesses; the inflammation of the feet may cause the horn to drop from the toes, producing great lameness and permanently injuring the animals; while abortion is frequent with pregnant animals. Altogether this causes a loss of 20 to 30 per cent of the value of the cattle. The disease generally spreads to sheep and hogs, causing proportionately severe losses with these animals.

The type of the disease varies, however, probably more than with any other malady affecting the domestic animals, and in some outbreaks it is extremely malignant. Fleming[a] said, in 1875, that it had been calculated that in recent invasions of the disease in Great Britain the average loss by death in those localities where it was very severe was 10 per cent, and Professor Brown stated that in one dairy in London 16 died out of 86.

Friedberger and Fröhner[b] state that sometimes the character of the disease is so malignant that 5 to 50 per cent of adult animals die and 50 to 80 per cent of the sucklings. The latter often die very rapidly, especially during the first few days after birth, while animals that are inclined to be weak and poorly nourished very frequently succumb.

Dr. Cope[c] stated at the International Veterinary Congress at Baden Baden, 1899:

> It is true that foot-and-mouth disease rarely assumes a fatal character, but the fact that nearly all classes of animals on the farm are susceptible renders the indirect losses much greater in the case of foot-and-mouth disease than rinderpest or pleuro-pneumonia, which only affect cattle. In my country where it existed

[a] George Fleming: A Manual of Veterinary Sanitary Science and Police. London, 1875. Vol. I, p. 466.

[b] Friedberger and Fröhner: Lehrbuch der Speciellen Pathologie und Therapie der Hausthiere. Stuttgart, 1900. Vol. II, p. 682.

[c] Seventh International Congress of Veterinary Surgeons. Baden Baden, 1899. Vol. I, pp. 184, 187.

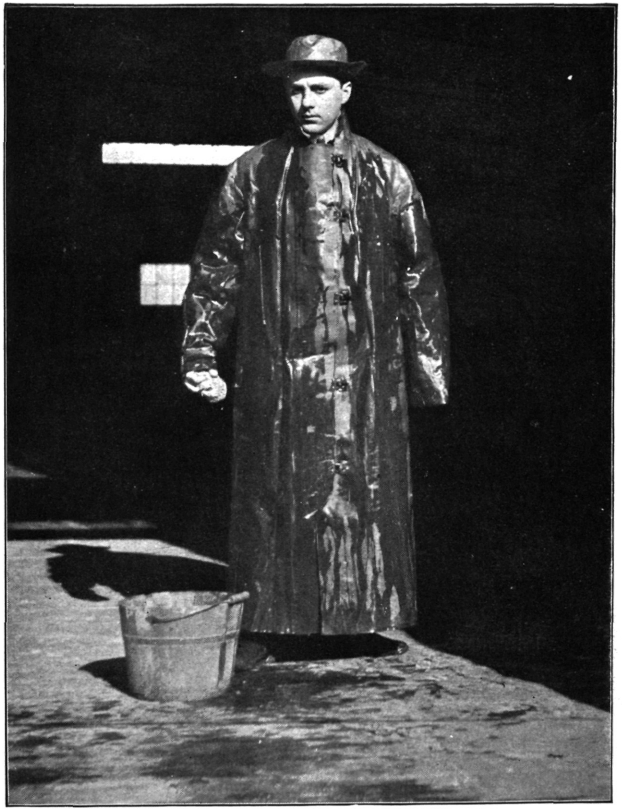


FIG. 1.—ATTIRE WORN BY INSPECTORS TO PREVENT CARRYING CONTAGION.

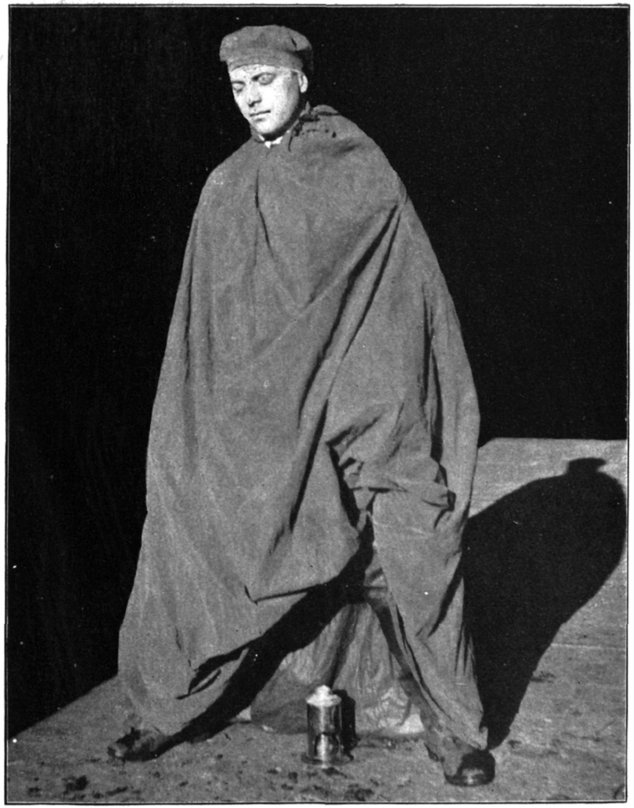
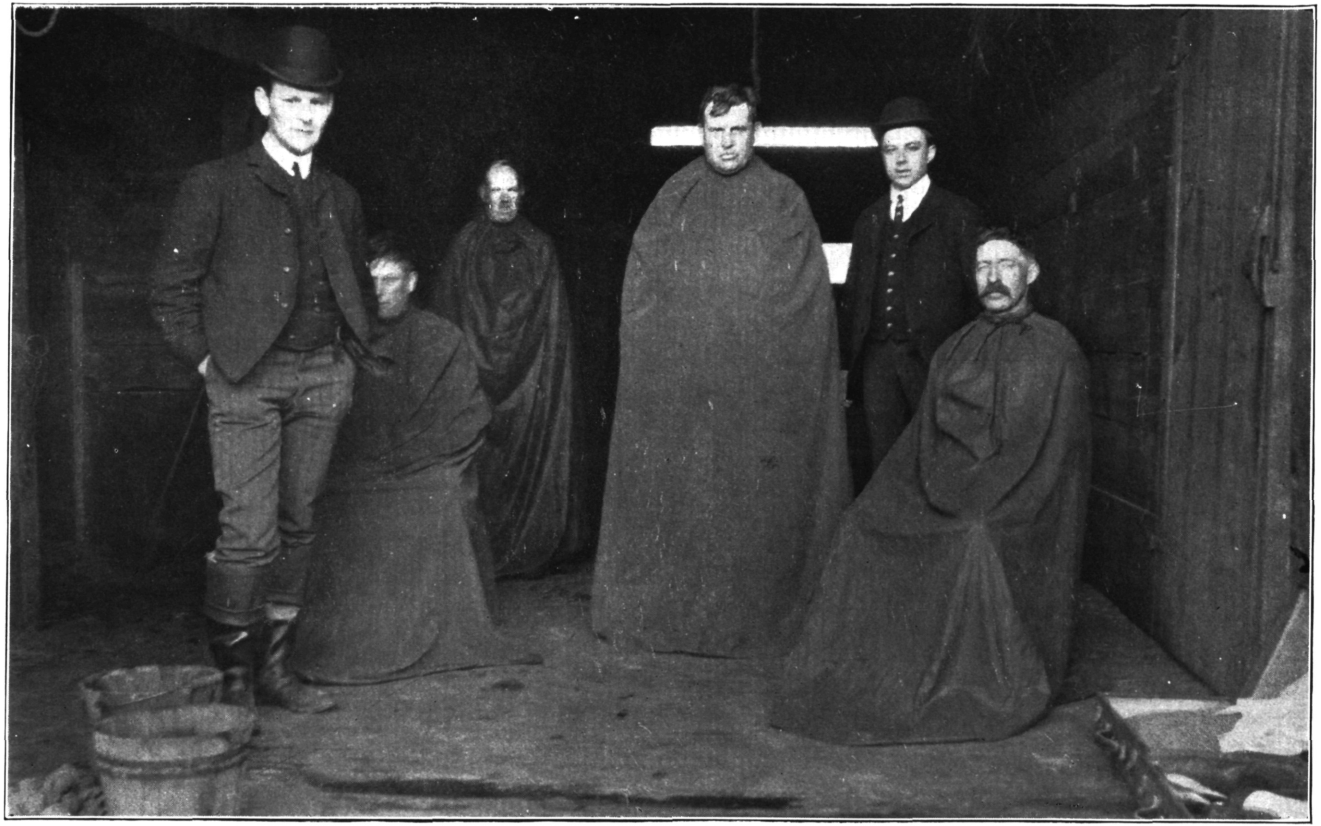


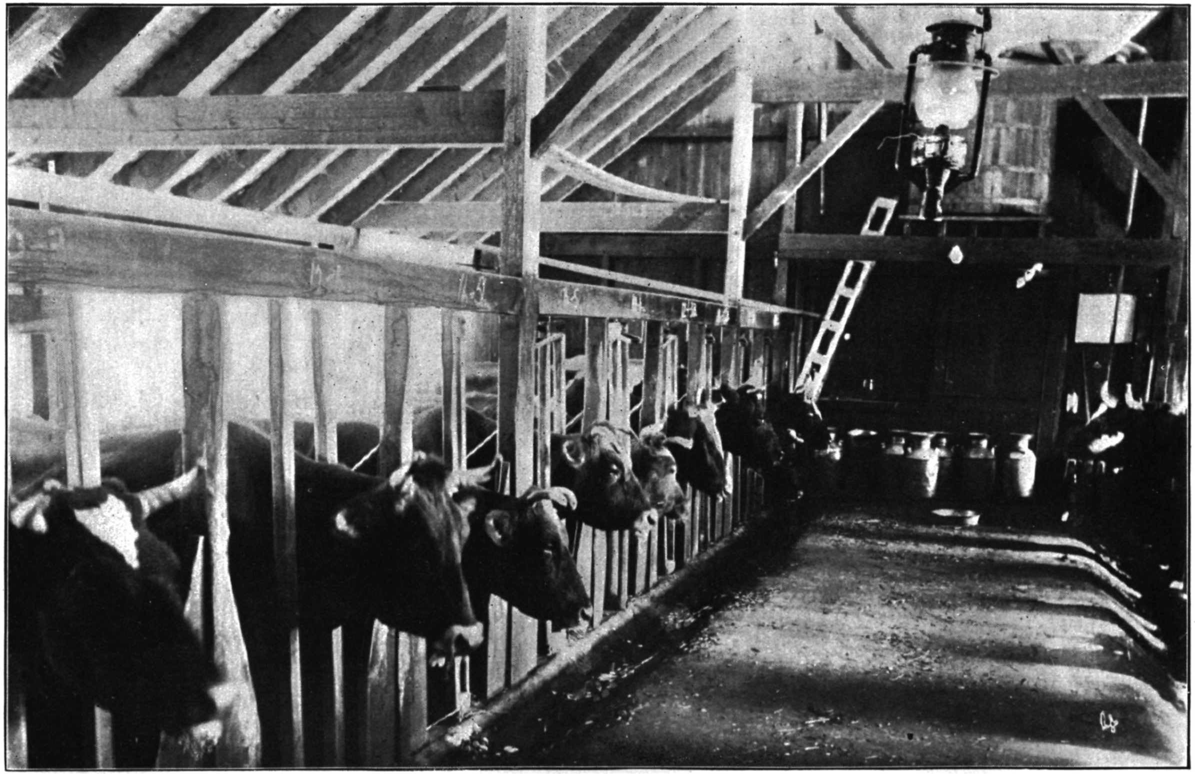
FIG. 2.—METHOD OF DISINFECTING INSPECTORS WITH FORMALIN GAS GENERATED BY LAMP PLACED UNDER RUBBER CLOAK.

The rubber coat, boots, and hat of fig. 1 were sponged off with disinfectant before going from infected premises to another place.

Cow Affected with Foot-and-Mouth Disease.



DISINFECTING LABORERS BY MEANS OF FORMALIN LAMPS PLACED UNDER RUBBER COATS.



Cows Affected with Foot-and-Mouth Disease—Dairy Herd at Westboro, Mass.

COWS AFFECTED WITH FOOT-AND-MOUTH DISEASE—DAIRY HERD AT WESTBORO, MASS.

for at least fifty years, it has caused enormous loss and inconvenience, greater than that of all the other contagious diseases of animals combined.

* * * * * * *

We have now been free from the disease since 1894, and I can assert that at the present time foot-and-mouth disease is more dreaded by the farmers and stock owners of Great Britain than cattle plague or pleuro-pneumonia, and they are now willing and ready to put up with any restrictions, of however drastic a character, considered necessary by the central department to stamp it out.

* * * * * * *

In fact, there are notable instances on record in which the breeding of pure-bred stock was abandoned. In many outbreaks where the disease appeared among the ewes, half of the lambs, and sometimes more, that were born at the time when their mothers were affected, died of the disease.

Hafner,[a] of Karlsruhe, gave an equally serious account of the ravages of the disease in southern Germany. He said foot-and-mouth disease had prevailed almost continually in Germany for a long series of years, and it had caused losses much greater than all other epizootic diseases combined. It had also been found that the disease, instead of following a benign course as formerly, had, during recent years, become very malignant. In fact, in numerous sections hundreds of cattle had suddenly died, and certain estates had lost from a third to a half of their stock.

These observations of men who have studied the disease for years where it has been almost constantly present, show what disastrous losses it causes and what a calamity it would be to a country like the United States to have the contagion spread over the whole extent of its territory. Not only would the immediate losses be tremendous, but the disease might linger on this continent, as it did in Great Britain, for half a century. To guard against such a calamity the most severe and rigid measures would be justified.

MEASURES FOR COMBATING THE DISEASE IN EUROPE.

ISOLATION AND QUARANTINE.

In Europe the disease has usually been combated by isolation and quarantine. But these measures have not been effective, as is shown by the continuous existence and the wide dissemination of the contagion. In considering the question as to whether quarantine would be practicable, it is well to inquire how long animals may spread the disease after they are affected by it. Hess, of Berne, at the Baden Baden Congress of 1899, contributed some observations of great interest in this connection.[b] He said that with 370 cattle affected with foot-and-mouth disease in the autumn of 1898 on the pastures of the Bernese Oberland, 7 of them, or nearly 2 per cent, propagated the disease

[a] Seventh International Congress of Veterinary Surgeons. Baden Baden, 1899. Vol. I, p. 350

[b] Ibid., Vol. I, pp. 404, 405.

in the course of the winter. From this he concluded that all cattle which recovered from foot-and-mouth disease should be, if possible, held in quarantine for five months, and that the owners of recovered cattle should not introduce new animals into their stables during this period of quarantine.

It has often been observed that cattle with chronic ulcers of the feet disseminate the disease a considerable time after they have apparently recovered; but this observation made by Hess, that recovered animals are only safe after a period of five months, makes the holding of diseased animals for recovery a much more serious matter than has heretofore been suspected. While diseased animals are alive they are constantly giving off the contagion by the saliva which escapes from the mouth and by the serum and pus which is excreted from the vesicles and ulcers of the udder and feet, and perhaps in other ways. While such animals are alive the stables are saturated with the contagion, and all persons or animals that leave such stables carry the contagion with them. When the animals are killed and the carcasses properly disposed of, the multiplication of this contagion ceases, and by ventilation and standing empty the stables become less and less infected, while if they are thoroughly disinfected with proper chemicals the danger of the disease spreading from them is arrested. There is probably no disease which is spread more easily than foot-and-mouth disease, and possibly none which is spread so easily, and it has in many cases been found impossible to stop its spread by quarantine measures.

Dammann,[a] of Hanover, at the Baden Baden congress, said that without an absolute quarantine of the infected farms, preventing even the movement of persons, the control of foot-and-mouth disease is not to be thought of; but this measure, he says, can not be executed. He further said that the very severe requirements of the sanitary law have not succeeded in eradicating the disease; and notwithstanding the quarantine of the infected stables, reinforced in many States by the quarantine of districts and often of a large zone around these; notwithstanding the very extended prohibition of animal markets and the supervision exercised over the abattoirs, dealers' stables, and railroad cars, the disease continued to prevail.

Dr. Loeffler[b] at the same congress said:

> Foot-and-mouth disease is spreading more and more every year; and every year it costs the German Empire enormous sums. Necessary measures had been taken with the greatest care; suspected grounds had been closely quarantined; this measure had been extended to whole communes, and even to entire districts; disinfection had been carefully carried out, and notwithstanding all this the disease kept spreading.

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[a] Seventh International Congress of Veterinary Surgeons. Baden Baden, 1899. Vol. I, pp. 270–272.

[b] Ibid., Vol. II, p. 109.

Cope[a] said that one of the most remarkable features of an outbreak which occurred in England "was the sudden appearance of the disease in Edinburgh, which is 400 miles distant from London, there being no center between London and that city. Every effort to trace how the virus of the disease was carried entirely failed, but the discovery of the fact that foot-and-mouth disease was capable of being conveyed for so great a distance by mediate contagion was one of the causes which led the board of agriculture to decide that the time had arrived for prohibiting the landing of animals from the whole of Europe, every other precaution which had been previously adopted to prevent its reintroduction having failed."

Such sudden extensions of the disease, although not to this distance, have been common in all outbreaks, and have excited more or less comment and speculation as to how they have occurred. Undoubtedly, the contagion may be carried a long distance in the clothing of persons who have been near the animals, and Hecker has proved that the feathers of pigeons which had picked up their food among infected chaff were infectious twelve hours afterwards.[b] He also produced the disease in dogs, cats, and rabbits by inoculation.[c] In the Massachusetts outbreak it has been suspected that the disease was carried in some cases by pigeons and in others by dogs, cats, and rats. These observations serve to explain to a certain extent the mysterious transmission of the disease from farm to farm over several miles of intervening territory.

SLAUGHTER OF DISEASED ANIMALS.

With a contagion which is so easily and frequently carried from farm to farm or from town to town, and in which efforts at control by quarantine have so generally failed, it becomes an important object to lessen the period of existence of the contagion as much as possible by slaughtering the diseased animals. In Europe slaughter has not usually been attempted, because the disease has been so widespread that this would necessitate the destruction of nearly the entire stock of cattle. However, slaughter has been frequently resorted to, and sometimes with marked success.

This disease was at one time taken to Australia. Fleming[d] says:

> There was really only one outbreak in Victoria among the cattle on two farms, into which it had been introduced by an imported bull. These cattle were destroyed and with them the disease.

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[a] Seventh International Congress of Veterinary Surgeons. Baden Baden, 1899. Vol. I, pp. 200–201.

[b] Ibid., Vol. II, p. 384.

[c] Ibid., p. 385.

[d] George Fleming: A Manual of Veterinary Sanitary Science and Police. London, 1875. Vol. I, p. 447.

Dr. Cope[a] speaks of a communication which he received from Dr. Bang, of Copenhagen, in which he says:

Since 1876 we have had every year, once or twice, a case of foot-and-mouth disease. In all cases we killed the cattle, sheep, and swine on the farms, even if only one calf was attacked.

Hess,[b] of Berne, at the Baden Baden congress, gave as one of his conclusions that the most efficacious and most economical measure to adopt against foot-and-mouth disease in most cases consists in the slaughter of all the infected animals. "The diseased animals," he said, "should be destroyed completely, including the hides and hair, and the exposed slaughtered under police supervision."

In England slaughter has been resorted to quite frequently in recent years to stamp out the disease when first introduced. Cope,[c] speaking of an outbreak in that country, says "it was eventually stamped out in the county of Kent by the purchase, slaughter, and burial of several of the affected flocks." Again, he says:

Later in the year, when the outbreaks were still further reduced in number, the privy council urged and succeeded in inducing some of the local authorities to stamp out the center of disease by slaughtering all the animals on the premises.[d]

With reference to the measures adopted, Cope[e] says:

Speaking generally it may be said that the latter consisted of the maintenance of strict isolation of all centers of the disease, disinfection of all persons and substances moved out of infected places, and sometimes the slaughter of whole herds of cattle and flocks of sheep, and finally, in order to prevent the reintroduction of the disease from abroad, it became absolutely necessary to prohibit the landing of animals from every country in the world in which foot-and-mouth disease existed or whose sanitary laws and regulations are inadequate to keep the disease out of their country or to prevent the exportation to Great Britain of diseased or infected animals.

In his report for 1900 Cope[f] says:

This was the only outbreak which occurred in the county of Suffolk during the year, but the disease soon after appeared on some farms in Norfolk within a few miles of this center on the following dates: January 30, at Freethorpe; February 4, 8, 10, and 19, at Ormesby, Freethorpe, and at Reedham. In all these instances the whole of the animals of the farms were slaughtered immediately after the

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[a] Annual Reports of Proceedings under Diseases of Animals Acts, etc., for 1900. London, 1901. P. 10.

[b] Seventh International Congress of Veterinary Surgeons. Baden Baden, 1899. Vol. I, pp. 391, 407.

[c] Ibid., Vol. I, p. 200.

[d] Ibid., p. 197.

[e] Ibid., p. 185.

[f] Annual Reports of Proceedings under Diseases of Animals Acts, etc., for 1900. London, 1901. P. 6.

nature of the disease had been confirmed, under the direction of the officers of the board who had been dispatched to the locality.

Further in the same report[a] it is said:

After the lapse of six weeks the disease reappeared in the month of September as far south as Melksham in Wilts. In this instance it spread from the first center to two neighboring farms. The nature of the disease reported by the local veterinary surgeon was confirmed by the board's own officials. The slaughter of all the cattle, sheep, and swine on the farms was immediately adopted, and since that date no further cases have been discovered in the west of England.

On October 5 a center was detected in the county of Stafford near Lichfield among some milch cows. The animals were examined at the request of the board by Mr. H. Olver, F. R. C. V. S., of Tamworth, a veterinarian of great experience, and his views as to the nature of the disease were confirmed by myself; the herd was killed as rapidly as possible.

* * * * * * *

Other outbreaks of foot-and-mouth disease were detected in Essex, in the immediate neighborhood of the former, on December 13, 15, and 18. Slaughter of all the animals on these farms was again rigorously enforced, but before it could be carried out 19 cattle on one farm and 14 on another fell with the disease.

The report of the assistant secretary of the animals division of the British Board of Agriculture for 1900 shows that slaughter of the animals was resorted to in 21 out of the 24 outbreaks of foot-and-mouth disease occurring in Great Britain during that year.[b]

Dr. Cope[c] says in his report for 1901:

However, on the 27th of January, 1901, a report was received of a suspected outbreak near Ipswich. The board immediately dispatched an expert to inquire into the nature of the disease, and he discovered after careful examination that 3 out of 39 head of cattle then on the premises were affected with foot-and-mouth disease in an unmistakable form, having vesicles not only in the mouth and on the feet but also upon the teats. * * * All the cattle on the farm were slaughtered with the utmost speed as soon as the nature of the disease had been confirmed.

Again, Dr. Cope[d] says:

The more recent experience in the administration of the foot-and-mouth disease order of the board has gone to prove that under the new system of stopping the movement of stock in widely extended areas, and of slaughtering in every instance where isolation can not be effectually carried out, a general outbreak of the disease can with certainty be arrested. This view is, I think, established by the fact that although the several centers discovered in 1900–1901 were very widely distributed in England and Wales, the measures adopted were so effectual that not a single case of foot-and-mouth disease found its way into a market, railway pen or truck, or into yards and lairs where animals are so frequently congregated by dealers prior to movement.

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[a] Annual Reports of Proceedings under Diseases of Animals Acts, etc., for 1901, London, 1902. P. 8.

[b] Ibid., pp. 25–28.

[c] Ibid., pp. 8, 9.

[d] Ibid., p. 13.

SLAUGHTER OF DISEASED ANIMALS INDORSED.

The above quotations are sufficient to show that the slaughter of diseased animals has been frequently adopted as a means of combating the disease in Europe, and that it has been more successful than any other measures. In fact, the International Veterinary Congress, held at Baden Baden in 1899, stated in one of its resolutions passed with reference to this disease that it was necessary to authorize slaughter and to establish uniform sanitary regulations.[a] It is plain that in Europe the failure of efforts to control the disease by quarantine and isolation is recognized, and that the slaughter of diseased animals is looked upon as the most efficacious measure that can be adopted. The disease has frequently been stamped out by this method when first introduced into a country. If slaughter is justified and recommended in Europe, where the disease so frequently occurs and is so prevalent, how much more is it to be recommended in a country like the United States, where it is confined to a very small territory and where there is such an enormous number of animals to be affected by it if it spreads beyond control.

NATURE AND CHARACTERISTICS OF THE DISEASE.

Foot-and-mouth disease is a highly contagious malady affecting ruminating animals (cattle, sheep, goats, deer) and hogs. No specific germ has yet been identified as the causative agent. In general the disease begins with an elevation of temperature amounting to from 2° to 6° F. and the formation of vesicles in the mouth, upon the udder and teats, and on the feet. These vesicles are of various sizes, the epidermis being raised by a clear exudate, which soon escapes by the rupture of the membrane. The membrane covering the vesicles is torn away by abrasion of the parts, or hangs in shreds, leaving a raw, ulcerated surface, which is extremely sensitive. When the vesicles appear in the mouth there is considerable salivation, the saliva gathering in a white foam about the mouth and attracting the attention of the observer. This is one of the first symptoms, and the salivation may be so abundant as to saturate the hay and floor in front of the affected animal. Plate LIII shows an affected cow with the saliva dribbling from her mouth, and Plates LV and LVI show some badly diseased animals in a dairy herd at Westboro, Mass., from the mouths of which there was an abundant flow of saliva. In Plate LVII there is shown a pair of diseased oxen with their mouths more or less open on account of the soreness and pain from which they are suffering. Affected cattle may also make a peculiar smacking sound with the mouth, which is no doubt due to the soreness of

[a] Seventh International Congress of Veterinary Surgeons. Baden Baden, 1899. Vol. II, p. 518.

the tongue or adjacent parts. When the disease is severe the vesicles in the mouth may be as large as a silver dollar; sometimes the whole mucous membrane appears congested and the epithelium loosened. When the tongue has been seized by the inspector to hold it while examining the mouth, the membrane has sometimes been stripped off by his hand, leaving the organ raw and bleeding and causing the animal the most acute suffering.

When the vesicles appear about the feet the animals may be seen to raise and shake the posterior extremities in a manner which indicates the pain that they feel in the affected regions. Large vesicles appear upon the udder and teats which interfere seriously with milking and from which secretions issue which may contaminate the milk at the time it is drawn. There is often congestion of the mammary glands, with induration and the formation of abscesses.

The acute stage of the disease is generally terminated within a period of two weeks, after which time convalescence occurs with more or less rapidity, according to the conditions of existence and the extremes of temperature to which the animals are subjected.

LOSSES BY THE DISEASE.

The disease is not one which produces a high fatality. The average loss by death in European countries has been from 2 to 5 per cent. The actual losses of cattle owners are, however, much greater than this. The high fever causes a rapid loss of flesh, which loss is augmented by the fact that owing to the large vesicles and resulting ulcers in the mouth the animals are not able to masticate their food. On account of this loss of flesh their value is decreased from 20 to 25 per cent. At the same time the milk secretion almost disappears, and the owner loses all revenue from his animals for from four to six weeks.

When the animals have recovered from the acute form of the disease many of them are found to be more or less injured, some of them having lost the horn from their feet, others having ulcers of the feet which cause chronic lameness, a considerable proportion having abscesses in the udder which make them worthless for milk production, while numerous others abort and become emaciated and of little value. On the whole, it is probably not far from correct to estimate that in an outbreak such as the present one in the New England States the average loss on account of the disease equals 50 per cent of the value of the cattle affected.

However, there is no disease in which different outbreaks vary more in their virulence than foot-and-mouth disease. In some outbreaks the cattle suffer but little, scarcely an animal dies, and the contagion spreads very slowly or dies out in a short time. In other outbreaks 50 per cent of the cattle may die, the disease is very contagious and spreads rapidly, and the contagion is carried long distances in the clothing of persons and in the hair of animals.

CONDITIONS IN MASSACHUSETTS.

In Massachusetts a number of herds were preserved which had the disease in a mild form and which had apparently recovered at the time the inspection was made. In about one-third of these cases the owners afterwards came in with the statement that a relapse had occurred with their animals; some were again affected with the formation of vesicles, and most of the others had abscesses in the udders, which made them unfit for milk production. At the time these cattle were slaughtered the udders of many of them were so distended with pus that they were ruptured as the animals fell, and discharged vast quantities of this liquid.

The present outbreak in Massachusetts has been a very virulent one. The disease has spread with extreme facility and has affected all of the cattle in the infected herds within a very few days, while the fever has been very high, the loss of flesh extreme, and the after results very unfavorable.

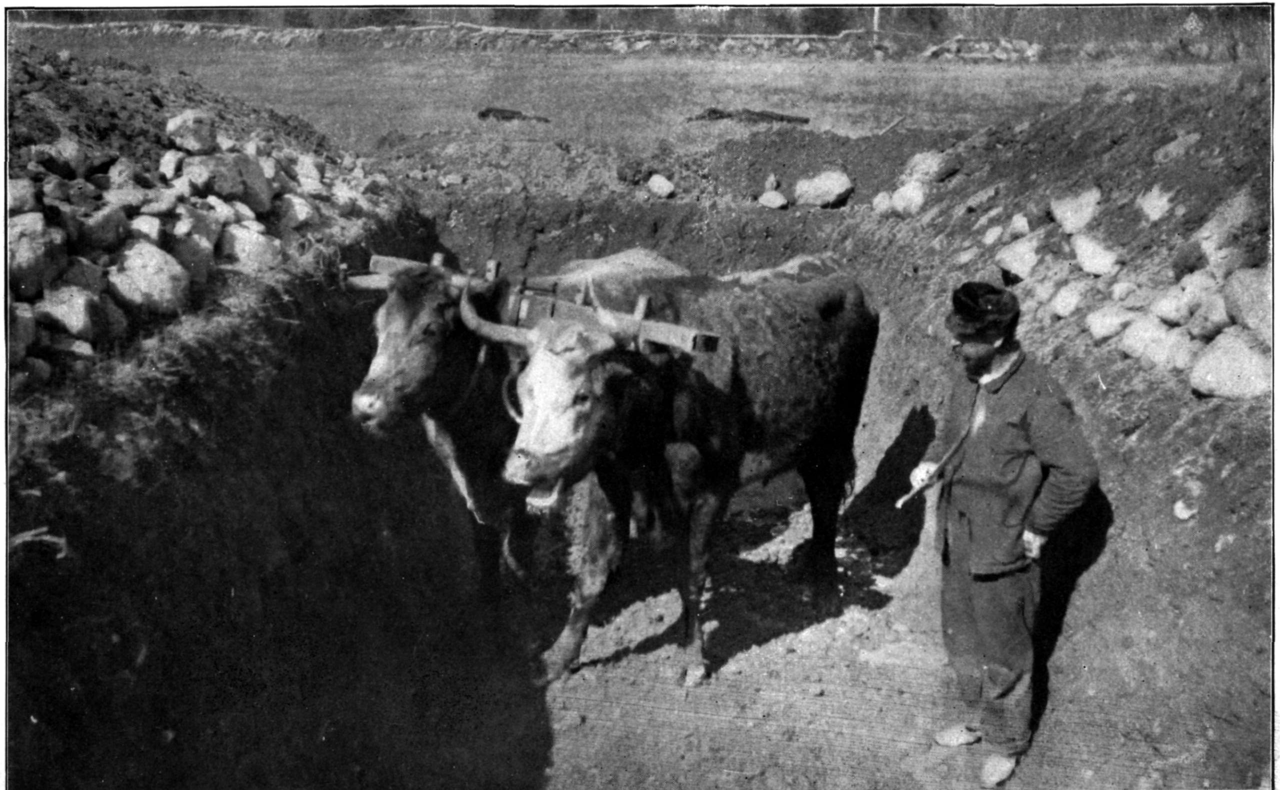
DISINFECTION OF PREMISES.

The disinfection of many of the premises where the disease was found proved to be a laborious and difficult undertaking. Some of the barns and stables were old, much of the woodwork was more or less decayed, there were mows containing hay and other forage, grain and feed bins, double floors with much organic matter between, and manure cellars, some of which contained hundreds of loads of manure more or less frozen.

A number of disinfecting squads were organized, each containing eight men, provided with a force pump for spraying the disinfecting mixture and with other utensils necessary for carrying out the process of cleaning and disinfecting.

The first step in the process was to clean out all the loose litter, scrape the woodwork and remove all dust and filth, take up the floors, and remove the manure from the cellars. After this was done the whole place was saturated with a mixture of lime wash and chloride of lime. Plate LVIII illustrates the manner of mixing the disinfecting solution in a half barrel, also the pump and hose and the manner of working this apparatus. The process is seen in operation in Plate LIX. Plate LX shows the interior of a barn which has been disinfected. During much of the time the temperature was below zero, and it was a difficult matter to keep the disinfectant from freezing before it could be applied.

It was necessary to disinfect some stables where the disease had been, but where all the animals had apparently recovered. These cattle were not killed, and it was found that the chloride of lime gave a disagreeable flavor to the milk and prevented its use for some weeks



Pair of Oxen Affected with Foot-and-Mouth Disease.

Disinfecting a Stable.

Disinfecting a Stable.

Whitewash containing disinfectants, after being mixed in a half barrel, is pumped through hose and applied in form of spray.

AN. RPT. B. A. I. 1902.

INTERIOR OF BARN AFTER DISINFECTION.

The intense cold has caused the disinfectant to freeze, as shown by icicles along edges of woodwork.

after the disinfection of the stable. To obviate this the chloride was dispensed with in such cases and formalin added to the whitewash in its place. It is doubtful if this is as efficient as the chloride of lime, but no complaints were made of its damaging the milk cans or the milk, nor has any cause of dissatisfaction been found with the stables so disinfected.

LIABILITY OF HUMAN BEINGS TO THE DISEASE.

The communication of the disease to people using the milk of diseased animals has been frequently reported in European outbreaks. With children especially the disease produced in this manner is quite serious and sometimes fatal. A few cases of this kind were reported during the Massachusetts outbreak, but they were not investigated, and it is not positively known that the disease affecting the people was identical with that of the cattle. In this outbreak the sale of milk was stopped as soon as the disease was found upon a place, and for that reason there was not the opportunity for the infection of mankind which exists when an outbreak is more extended and affects practically all the milk-producing animals of a country. However, people were advised to pasteurize the milk which they used, and thus avoid any possibility of infection.

DIFFICULTIES OF CONTROL.

With about one hundred herds already affected when the Department began active operations for eradicating the disease, and with new cases appearing daily, it was a matter of impossibility to dispose of all the diseased animals at once. The severe weather impeded the work considerably, and for a time it seemed that new cases were developing faster than the old ones could be put out of the way. In order to get the outbreak under control and to prevent, so far as possible, the spread of the disease, the general plan was adopted of slaughtering first the herds on the outskirts of the infected district and then working toward the center, thus restricting and gradually lessening the area of infection. As a result there was very little extension of the disease beyond the territory affected when the work was commenced, and the spread of the contagion was soon checked. Within thirty days the force had so far caught up with the work that it was possible to dispose of every newly affected herd soon after it was reported, and by the end of January, 1903, practically all the diseased animals had been destroyed so far as then known to the Department.

The progress of the work, especially in Massachusetts, demonstrated in a striking manner the efficacy of slaughter and the futility of relying upon quarantine alone in stamping out the disease. Just so long

as any considerable number of diseased herds remained alive giving off contagion which might be disseminated by people, dogs, cats, rats, chickens, and pigeons, and possibly through other agencies, in spite of the local quarantines, so long did the disease continue to spread rapidly. And as the number of herds which were the sources of contagion was reduced, the spread of the disease was proportionately diminished and arrested.

It is unfortunate, however, that in Massachusetts and New Hampshire the withholding of information and the failure to report the the disease to the authorities, and the evident intention of some of the people to conceal it, has resulted in prolonging the period of infection and the time for which the quarantine was necessary. When it was supposed that the disease had been eradicated, a house-to-house inspection was instituted in Massachusetts in order to make sure that the contagion no longer existed, and this inspection revealed a number of herds still affected. Early in March the disease was found among a lot of 11 cattle received at Watertown, Mass., from Bedford, N. H., and an investigation at the place of origin disclosed quite a number of affected herds throughout the neighboring townships. These discoveries necessitated a thorough canvass of the whole infected district, which required considerable time and resulted in the finding of other diseased herds from time to time in Massachusetts and New Hampshire, though no more were found in Vermont and Rhode Island.

Some of these herds bore evidences of having been affected for some weeks. Every day that such a herd was held by its owner without reporting it gave opportunities for the spread of the infection and also lengthened the period of quarantine. If all such cases had been promptly reported the disease could have been entirely eradicated within a few months and the affected States relieved from the quarantine restrictions which weighed so heavily upon the farming and commercial interests, but on account of the concealment of the disease it has been necessary to maintain the quarantine for at least twice the period which would otherwise have been required.

SUPPLEMENTAL ORDERS RELATIVE TO QUARANTINE.

In accordance with the developments of the situation from time to time, various orders and regulations were issued. On November 29, 1902, the quarantine was modified so as to permit the shipment, for immediate slaughter, of animals from outside the quarantined district across and into that district, under certain restrictions as to sealing of cars, inspection, etc. This was done to avoid, so far as possible, interference with the meat supply of the infected district. On December 13 an order was issued providing for the disinfection and return of stock cars from outside the infected territory, and also placing a

quarantine upon hides and other products of susceptible animals in the quarantined States. On January 23 and February 2, 1903, amendments were issued permitting the shipment of animals from Vermont to certain points in Massachusetts, in certain cases and under certain restrictions, and allowing certain animal products to be taken out of Vermont. On March 7 the State of New Hampshire was placed in quarantine, on the discovery of further infection, as heretofore stated.

An act of Congress giving to the Secretary of Agriculture greater powers in dealing with contagious diseases of animals having been approved February 2, 1903, a new quarantine order covering the State of Massachusetts was issued on April 15, so as to bring the regulations under the authority conferred by that legislation. On May 1 the quarantine was removed from Vermont, with the exception of certain townships in and near which the disease had existed, and provision was made for animals to be released from these townships on inspection and permit. On May 9 the quarantine was removed from Rhode Island. On May 12 an order was issued providing for the movement of animals from Vermont into Massachusetts across New Hampshire for purposes other than immediate slaughter; from New Hampshire into Massachusetts for immediate slaughter at certain points, and from Massachusetts into New Hampshire for pasturage, in certain cases and under certain restrictions. An arrangement was also made for issuing permits allowing persons whose farms were located partly in one State and partly in another to move their animals across the State line within the limits of their farms.

SEVERE PRECAUTIONARY MEASURES NECESSARY.

Owing to the treacherous nature of the foot-and-mouth disease and to the ease and rapidity with which the contagion spreads, it has been necessary to take the utmost precautions and to guard every channel by which there seemed to be a possibility of the contagion escaping to other parts of the country; and while the restrictions have caused some hardship and may have seemed unduly severe to some persons, they have been no more rigorous than was considered necessary to accomplish the object in view, and they have been relaxed or removed just as soon and to such an extent as it appeared that this could be done with safety.

The effect of the quarantine on animal products was to prevent for a time the shipment of a large quantity of hides and wool, to the great inconvenience of the trade. The Department felt justified, however, in taking strict measures with regard to interstate traffic in such articles. If there was a single infected hide among a large lot, or if the wool from a single diseased sheep had been mixed with a large amount from healthy sheep, there was still some danger of the contagion being carried by these products. The contagion was most

probably introduced into the United States by some article or material which had been exposed to infection, and not by diseased animals themselves; and there was just as much probability that it might be conveyed to other parts of the United States in a similar manner. In order to relieve the situation as much as possible, a thorough investigation was made into the origin, history, and condition of storage of the stocks of wool and hides, and in cases where it could be clearly shown that the products had come from uninfected sections and had not been exposed to contagion they were released for shipment.

In making investigations of this character and in supervising the movements of animals and animal products there was involved a vast amount of work besides that relating directly to the eradication of the disease.

SCIENTIFIC EXPERIMENTS NOT PERMITTED.

No scientific investigations or experiments were conducted by the Department with the exception of the inoculation tests made soon after the discovery of the disease for the purpose of confirming the diagnosis. Foot-and-mouth disease has been the subject of investigation and study by scientists in Europe and in other parts of the world for many years, and it was considered doubtful if any new scientific facts concerning its nature could be brought to light during the brief period to which it was hoped that its presence in this country would be limited. There was some danger that the propagation of the disease for experimental purposes might result in the escape of the contagion beyond control. Although members of the scientific staff of the Bureau and others were desirous of making some investigations, it was decided that the risk was too great and the chance of accomplishing any good results too remote for this to be permitted.

NUMBER OF ANIMALS AFFECTED, NUMBER SLAUGHTERED, COMPENSATION PAID, ETC.

The tables which follow show the number of herds and animals found affected with foot-and-mouth disease, the number slaughtered, the compensation paid, etc. These figures include all the animals in the infected herds, whether they showed symptoms of the disease or not. As in an outbreak of this disease all the animals exposed contract it in the course of a week or two, it was assumed that where one or more animals in a herd showed clear evidence of the disease all the rest were affected.

The difference between the number of cattle affected (4,712) and the number slaughtered (3,872) represents those that either died or recovered. Nearly all the recoveries were in the early cases, where the

disease had run its course before the work of slaughtering was begun or before those herds could be reached. After the commencement of the work of eradication no newly affected herds were allowed to be held for recovery.

Number of herds and cattle affected with foot-and-mouth disease since the beginning of the outbreak, as reported by months.

Month.	Massachusetts.		New Hampshire.		Vermont.		Rhode Island.		Total.	
	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.
November, 1902 [a]	62	1,219			4	47	7	234	73	1,500
December, 1902	71	1,536	4	37	17	288	8	110	100	1,971
January, 1903	9	225							9	225
February, 1903	6	196			1	16	3	16	10	228
March, 1903	3	55	28	444					31	499
April, 1903	3	9	15	221					18	230
May, 1903	2	28	1	31					3	59
Total	156	3,268	48	733	22	351	18	360	244	4,712

[a] These are the figures of official record, but it is known in a general way that there were more animals affected previous to November.

Animals slaughtered by United States Department of Agriculture.

State.	Herds.	Cattle.	Hogs.	Sheep and goats.	Total animals.
Massachusetts	129	2,708	229	55	2,992
New Hampshire	48	733	68	100	901
Vermont	22	351	55	74	480
Rhode Island	6	80	8		88
Total	205	3,872	360	229	4,461

Appraised valuations and compensation paid for animals slaughtered.

State and animals.	Number.	Appraised value on health basis.	Average per head.	Net compensation (70 per cent).	Average per head.
Massachusetts.					
Cattle (not including calves)	2,589	$131,238.58	$50.69	$91,867.00	$35.48
Calves	119	1,021.79	8.59	715.25	6.01
All cattle	2,708	132,260.37	48.84	92,582.25	34.19
Hogs	229	2,269.43	9.91	1,588.60	6.94
Sheep and goats	55	444.00	8.07	310.80	5.65
Total	2,992	134,973.80		94,481.65	
New Hampshire.					
Cattle (not including calves)	668	28,704.00	42.97	20,092.80	30.08
Calves	65	539.00	8.29	377.30	5.80
All cattle	733	29,243.00	39.90	20,470.10	27.93
Hogs	68	574.50	8.45	402.15	5.91
Sheep	100	497.00	4.97	347.90	3.48
Total	901	30,314.50		21,220.15	
Vermont.					
Cattle (not including calves)	301			9,348.00	31.06
Calves	50			590.00	11.80
All cattle	351			9,938.00	28.31
Hogs	55			429.32	7.81
Sheep	74			325.75	4.40
Total	480			10,693.07	
Rhode Island.					
Cattle (not including calves)	79	3,523.00	44.59	2,466.10	31.22
Calves	1	3.00	3.00	2.10	2.10
All cattle	80	3,526.00	44.08	2,468.20	30.85
Hogs	8	65.00	8.12	45.50	5.69
Total	88	3,591.00		2,513.70	

SUMMARY.

Animals.	Number.	Net compensation.	Average per head.
Cattle (not including calves)	3,637	$123,773.90	$34.03
Calves	235	1,684.65	7.17
All cattle	3,872	125,458.55	32.40
Hogs	360	2,465.57	6.85
Sheep and goats	229	984.45	4.30
Total compensation paid		128,908.57	

VOGES'S DESCRIPTION OF MAL DE CADERAS

A South American Trypanosomatic Disease of Domestic Animals.

By CH. WARDELL STILES, Ph. D.,
Consulting Zoologist of Bureau of Animal Industry.

The attention of the United States Government has recently been called to a serious malady of horses in the Philippines. This disease is known as surra, and is caused by a protozoon, *Trypanosoma evansi* by name, which lives in the blood plasma and destroys the red-blood corpuscles.

As soon as surra was diagnosed in the Philippines the Bureau of Animal Industry prepared an emergency report on the subject,[a] discussing not only surra, but also allied maladies, such as tsetse-fly disease, dourine, and mal de caderas—three other equine maladies described as being due to trypanosomatic parasites. At the time the report in question was written little was known regarding mal de caderas, but just after the proof sheets were returned to press, and too late to make additions, an important paper on mal de caderas[b] appeared. This article contains many facts of interest to North American veterinarians and stock raisers, and on this account an extended review of Voges's paper is here given, so that mal de caderas may be compared with surra, as described in the bulletin just mentioned.

The name "mal de caderas" is a vernacular term based upon one of the chief symptoms, namely, a paraplegia of the haunches, and means "disease of the haunches."

The disease appears to have existed for some years past in the central portion of South America. Although the first published reports date but a few years back (1899), an account of the malady was sent to Europe as early as 1842, but did not receive any attention. Voges divides the disease into two stages.

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[a] Salmon and Stiles. "Emergency Report on Surra; with a Bibliography of Allied Trypanosomatic Diseases, by Albert Hassall." Bulletin No. 42, Bureau of Animal Industry, United States Department of Agriculture, Washington, D. C., 1902, pp. 152, 112 illustrations.

[b] O. Voges. "Das Mal de Caderas." Zeitschrift f. Hygiene u. Infectionskrankheiten, Leipzig, vol. xxxix, (3), März 13, pp. 323-371, pl. 5, figs. 1-7. [W[a].]

First stage: In experimental cases, if 5 to 20 c.c. of blood from a sick horse are injected into a healthy horse a fever develops four or five days later, increasing from hour to hour, and remitting somewhat on the following morning, or increasing steadily to 40° or 41° C. During the following day the temperature falls to or near the normal, usually reaching its lowest point on the second day. The temperature now rises again, day by day, until after another five days it again reaches or exceeds 40° C. This alternation occurs two, four, or even six or eight times in succession, the intermissions usually varying from three to six days. Pulse and respiration remain normal, and there is scarcely any change in the appetite except that in the evening, at the height of the fever, the appetite is slightly diminished; thirst increases. The feces are usually normal, but occasionally contain blood. Temporary hemoglobinuria develops, and hematuria becomes almost constant. Sight and sense of hearing remain normal. The coat remains smooth and glistening, and in case the attack occurs during the period of the fall of the hair this process occurs in the normal manner. Reflexes are normal. The intermittent fever is the most characteristic of all the symptoms.

Second stage: The transition to the second stage is gradual. As the disease progresses the intermittent character disappears. The fever does not rise so high, 40° and 41° C. being exceptional; the remissions are also less prominent. The temperature usually varies between 38.5° and 39.8° C. The animal lacks energy; the head hangs; the entire posture of the body becomes indolent, and even the wildest and meanest animals show no disposition to bite or kick. The patient becomes emaciated, although the appetite continues; thirst continues, and even increases.

Proportionally to the increasing general weakness of the body the heart becomes weaker, so that it can not propel the blood; edema develops, especially in the hind legs; the coat becomes staring. The sensibility is so decreased that the horse makes no effort to rid himself of the swarm of flies which settle upon him, but in some cases reflex movement remains unimpaired. Respiration, digestion, and feces remain normal or nearly so. Hemoglobinuria is usually absent, but the urine nearly always contains red-blood corpuscles. Urination is frequent and abundant, owing to the large amount of water taken in. The animal shows no signs of pain.

The gait is not always normal. In some cases the animals drag themselves slowly forward; in others their walk resembles that of a drunken man. The patients may fall, and then become so exhausted in their efforts to rise that they die within twenty-four hours. If they are "tailed up," however, they may continue to live eight to fourteen days longer; some animals are able to stand and walk to the last. Toward the end the temperature undergoes marked changes, varying from morning to evening between 34° and 39° C.;

death rarely occurs during a high temperature. The entire illness may last from fourteen days to more than four months.

GROSS PATHOLOGY.

Staring coat and the above-described edema are present. The hide is removed with difficulty, as the flesh is usually very dry, similar to the condition found in cholera patients. The pleural cavities contain a serous, yellow, usually clear or only slightly clouded exudate, often several liters in amount and containing red and white blood corpuscles. Fibrous deposits are found on the pleuræ in small or in larger quantities. Lungs are normal. The cardiac sac is filled with a large amount of exudate similar to that found in the pleural cavity. The cardiac muscle is normal or dilated and pale like the other muscles. The lymphatic glands are slightly swollen. The abdominal cavity contains an exudate similar to that found in the pleural cavity and similar fibrinous deposits are found, especially upon the liver. The intestinal canal appears normal. The spleen is enormously enlarged, the enlargement being in proportion to the length of the attack. The liver also in enlarged. The kidneys are pale on section, and they, too, may be enlarged. The lymphatic glands are often swollen.

SEASONAL CONDITIONS.

The disease occurs only in regions where swamps exist. It is also reported to be a wet-weather disease, and Dr. Kemmerich is quoted as authority for the statement that, if the plants are removed from a swamp and a permanent wave motion provided for, the disease is controlled. Kemmerich also advises that horses be kept in stables instead of in camps, and reports that this precaution resulted in stopping the disease.

In droves of horses in which the malady has broken out the disease may be arrested by taking the animals to a high, dry locality.

ECONOMIC IMPORTANCE.

Mal de cadèras is of great importance from a military standpoint, as is seen from the fact that five cavalry regiments lost 1,039 horses and 489 mules within six months, the deaths being due to this disease. The morbidity varies from 25 to 100 per cent. The lethality of mal de caderas is placed at 100 per cent.

THE BLOOD.

The blood count shows an enormous decrease in red-blood corpuscles—from 10,000,000 down to 4,000,000 or 3,000,000, or even as low as 800,000; at the same time there is an increase in the white-blood

corpuscles. Subcutaneous injections of blood from diseased animals result in causing the disease, but experiments with the blood filtrate as well as with ingestion of blood were negative. The hemoglobin decreases from 13.1 per cent to 3 or 4 per cent.

THE PARASITE.

Mal de caderas is a blood disease, like surra, caused by a parasitic protozoon, to which Voges in his preliminary paper gave the name *Trypanosoma equinum.* Voges's present description does not permit us to distinguish clearly between *Trypanosoma equinum* and certain allied species of the same genus. The reproduction of the parasite is described as consisting of (1) a longitudinal division, or (2) a transverse division, or (3) segmentation; but it seems probable that at least some of the cases of alleged transverse division represent the agglutination of the parasites. The organisms appear in the blood about five days after infection, increasing in proportion to the rise in temperature until, as a rule, they suddenly disappear when the fever reaches 40° C. About three to five days later they can again be discovered, and they increase again in proportion to the animal's temperature. At their height they are about 10 to 25 per cent as numerous as the red-blood corpuscles. In the second stage of the disease this periodicity of the parasite becomes more or less obscure.

The important fact was determined that the blood is usually non-infectious twenty-four to forty-eight hours after death, thus showing a marked difference from bacterial diseases like anthrax.

ANIMALS AFFECTED.

Asses and mules are much less susceptible to the disease than horses.

Mice, both the white and the gray, are especially susceptible. In twenty hours after the inoculation of white mice it is possible to find trypanosoma in the blood. Gray mice are less susceptible, and the parasites are not found until about three days after inoculation. In the case of white mice the parasites increase so rapidly that on the fourth or fifth day they are more numerous than the red-blood corpuscles. Gray mice die about twelve to fourteen days after infection. All mice, without exception, die on the first attack. Thus mice are exceedingly susceptible to the disease, and are therefore very valuable as aids in diagnosis.

Rats are also susceptible. In the case of white rats the parasites appear in the blood of the tail four to five days after infection. Crosses between the white rat and the wander rat are more resistant, the protozoa not appearing in the blood until the fifth to the seventh day. As in the case of infection of mice, the parasites increase to such an extent in rats that the protozoa outnumber the red-blood

corpuscles. The wander rat is still more resistant, and in some cases the parasites disappear temporarily from the circulation. Most rats, however, die in the first attack.

Rabbits may live from one to three months after infection. The parasites may not be evident in the circulation for four weeks after inoculation. There is profuse lacrymation, the conjunctivæ become catarrhal, the eyes become dim, and a pus-like secretion forms, by which the lids are closed. In bucks the testicles swell and become inflamed, and similar changes appear in the vulva of doe rabbits.

Dogs contract the disease and live two to three months. The edema is quite prominent, especially on the head and eyelids. The conjunctivæ become affected, and the eyes become dull and more or less inflamed, conditions which are similar to those which take place in rabbits. The edematous condition of the scrotum is striking, but the penis is not affected. The dog is about as susceptible to mal de caderas as the rabbit or slightly less so. There are times when the parasite almost or quite disappears from the blood.

In sheep and goats the disease is fatal, but the animals may live for months without showing any special symptoms; then they become emaciated and suddenly die. The appearance of the parasites in the blood is periodical.

The disease was fatal to a monkey (*Nictipithecus felinus*).

Cats die about four weeks after infection without having shown any special symptoms during the disease.

Two specimens of *Nutria* were also killed with mal de caderas about ten days after infection.

Guinea pigs are much less susceptible than the other animals, only about one-half to two-thirds of the infected animals dying. Death occurs from two to five months after infection.

Cattle appear to be immune, and Voges records a case where an animal was kept one and a half years, and, despite the fact that it was inoculated with large quantities of trypanosomatic blood, it gained in weight.

Mal de caderas is transmissible also to birds, and Voges inoculated chickens, ducks, and turkeys with fatal infections. Chickens die in the second or third week. During the disease they become very emaciated, but exhibit no other symptoms.

Voges's views relative to the cause of mal de caderas were opposed in South America, and in reply to his opponents he argues that *Trypanosoma equinum* of the horse can not be identical with *Trypanosoma lewisi* of rats. The disease is, however, similar to dourine and also similar to surra (Voges unites surra and nagana), but Voges considers mal de caderas distinct from both dourine and surra.

In reference to transmission, Voges has experimented with bloodsuckers, with negative results, and he now suspects flies belonging to the species *Musca brava*.

DIAGNOSIS.

The disease may be diagnosed with the aid of the microscope. Diagnosis of doubtful cases is made possible by injecting 1 or 2 c. c. of blood from the suspected horse into a mouse; the blood of the latter may then be examined after one to four days.

TREATMENT.

Experiments in treatment with quinine, methylene blue, enterol, salicylate of soda, turpentine oil and permanganate of potash, iodide of potash, and intravenous injection of corrosive sublimate were all negative. Arsenious acid gave temporary favorable results. Experiments in serum therapy were negative.

CONTAGIOUS DISEASES OF ANIMALS IN FOREIGN COUNTRIES.

By George Fayette Thompson, M. S.,
Editor Bureau of Animal Industry.

GREAT BRITAIN.

SWINE FEVER.

The number of outbreaks of swine fever reported in 1901 was 3,140, and was an increase over 1900 of 1,200. The Eighteenth Annual Report of this Bureau (p. 591) shows the number of outbreaks in England, Scotland, and Wales for the years 1894 to 1900, inclusive. The accompanying table, taken from the report of A. C. Cope, chief veterinary officer, shows the number of counties where the disease existed and the number of outbreaks, by months, for the year 1901:

Month.	Number of counties.	Number of outbreaks confirmed.	Month.	Number of counties.	Number of outbreaks confirmed.
January	35	132	August	39	221
February	38	159	September	38	134
March	51	334	October	26	103
April	55	462	November	37	138
May	52	478	December	32	104
June	48	550	Total for the calendar year		3,140
July	45	325			

The explanation of the increase of this disease is thus succinctly stated by Maj. J. T. Tennant, assistant secretary of the animals division of the board of agriculture:

> The increase of the disease was mainly due to the strenuous resistance offered, both by local authorities and stockowners throughout the country, to the general restrictions which had brought about a considerable decrease of the disease toward the fall of the preceding year, and to the fact that the efforts of the police and others intrusted with the enforcement of such regulations had, during the winter months, been somewhat relaxed.

FOOT-AND-MOUTH DISEASE.

In January, 1901, this disease reappeared in England, and afterwards during the year broke out at several places, attacking both cattle and sheep. The authorities were unable to determine how the disease was introduced, but were able to trace most of the later outbreaks to the first one. During the year a total of 43 cattle and 626 sheep were attacked.

GLANDERS.

As in 1900, there was a marked increase in the stables infected with glanders over 1899, so in 1901 there was a large increase over 1900. In 1900 there were 1,119 outbreaks, when 1,858 horses were attacked, while in 1901 the outbreaks numbered 1,347, and the number of horses attacked 2,370.

ANTHRAX.

Anthrax was prevalent in 1901, there being 651 outbreaks reported. In 1900 the number of outbreaks was 571. In 1901 the following animals were attacked: Cattle, 708; sheep, 76; hogs, 152, and horses, 35. In 1900 668 cattle, 40 sheep, 204 hogs, and 35 horses were attacked. Attention is called to the almost certain possibility that many animals died of the disease before a veterinarian was called upon.

SHEEP SCAB.

Sheep scab was discovered in 74 counties of England, Scotland, and Wales, and the number of outbreaks was 1,537. In the previous year the counties affected numbered 78 and the outbreaks 1,939. The outbreaks in 1901 were fewer than for any year since 1890, and the number of sheep attacked was 22,764; in 1900 the number attacked was 26,610.

SWITZERLAND.

The item of special interest among the diseases of domestic animals in Switzerland, and one to be regretted, is the persistence of foot-and-mouth disease. The number of cases and the animals suspected in 1901 were 8,110, which was a reduction from the previous year, when the number of actual cases was 11,469. In 1902 the actual cases numbered 15,531. The extent of the disease in June, July, and August was alarming. Reports for other diseases vary but slightly from those of 1901.

Cases of contagious diseases among domestic animals in Switzerland for the year 1902.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Blackleg	11	12	15	37	28	44	116	149	125	57	27	17	638
Anthrax	32	24	40	31	27	17	14	14	18	18	21	23	279
Foot-and-mouth disease	342	223	601	43	2	1,420	9,070	2,911	206	75	179	459	15,531
Rouget	88	68	375	170	357	193	475	299	244	173	249	104	2,795
Sheep scab			8	15	20	4	5						52
Scab of goats								3					3
Tuberculosis	1	8		1	2					3	4	1	20
Rabies			5		2	2	2				3		14
Glanders and farcy	3	3	6	1	3	6				7	7	1	37

FRANCE.

In France it was specially noticeable that the number of cases of foot-and-mouth disease for the year 1902 was very much reduced. The number was 9,152, whereas it was 37,397 in the previous year and 77,604 in 1900. The disease of rabies was still prevalent, with 2,325 cases, being but about 400 fewer than in 1901. Other diseases prevailed to about the same extent as in the previous year.

Contagious diseases among domestic animals in France during the year 1902.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.
Contagious pleuro-pneumonia:						
Number of outbreaks	1	4	1		5	
Number slaughtered	1	4	8		4	
Foot-and-mouth disease (outbreaks)	986	1,021	906	444	433	487
Sheep scab (outbreaks)	5	4	10	15	5	5
Sheep pox (outbreaks)	24	7	8	7	6	13
Anthrax (outbreaks)	26	30	31	32	28	29
Blackleg (outbreaks)	47	50	33	31	39	38
Glanders and farcy:						
Number of outbreaks	28	39	38	43	49	47
Horses slaughtered	44	60	111	69	99	54
Rabies (cases)	228	184	248	204	167	228
Rouget (outbreaks)	32	27	33	28	39	40
Hog cholera (outbreaks)	21	30	39	12	7	9

Name of disease.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Contagious pleuro-pneumonia:							
Number of outbreaks	2	3	1	1		2	20
Number slaughtered	3	3	3	3		5	34
Foot-and-mouth disease (outbreaks)	795	824	1,423	843	535	455	9,152
Sheep scab (outbreaks)	15	2	4	11	16	7	99
Sheep pox (outbreaks)	11	25	26	32	35	16	210
Anthrax (outbreaks)	57	46	19	52	25	20	395
Blackleg (outbreaks)	40	51	43	69	93	48	582
Glanders and farcy:							
Number of outbreaks	36	41	44	41	48	43	497
Horses slaughtered	167	53	68	74	45	60	904
Rabies (cases)	227	164	176	142	170	187	2,325
Rouget (outbreaks)	50	49	54	48	32	29	461
Hog cholera (outbreaks)	25	9	23	16	23	10	224

GERMAN EMPIRE.

The reports concerning the contagious diseases of animals for the German Empire are taken from Veroffentlichungen des Kaiserlichen Gesundheitsamtes, the official organ of that Empire. It will be noticed that the localities and farms only are given, and we have no means for determining the actual number of cases of the different diseases.

A comparison of the year 1902 with the year 1901 shows a large increase in the number of farms having glanders—662 in 1901 and 987 in 1902. For the same period pleuro-pneumonia increased from 113

affected farms to 193, and hog cholera and swine plague from 7,699 to 21,927. Foot-and-mouth disease decreased from 6,483 to 3,087.

Number of localities and farms infected with contagious diseases of animals in the German Empire for the year 1902.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Glanders and farcy:													
Localities	79	74	79	85	85	72	76	68	52	55	47	48	820
Farms	100	93	94	99	98	85	93	83	63	64	56	59	987
Pleuro-pneumonia:													
Localities	17	14	19	18	18	15	10	8	9	7	7	5	147
Farms	27	26	27	25	23	18	11	8	9	7	7	5	193
Foot-and-mouth disease:													
Localities	247	271	299	151	63	61	64	71	59	37	41	58	1,422
Farms	763	492	554	274	119	88	102	161	189	90	111	144	3,087
Hog cholera and swine plague:													
Localities	897	1,060	1,279	1,469	1,644	1,752	1,741	1,683	1,593	1,388	1,409	1,371	17,286
Farms	1,147	1,397	1,693	2,032	2,119	2,209	2,195	2,083	1,981	1,722	1,713	1,636	21,927

BELGIUM.

The reports at hand do not state how many cases of foot-and-mouth disease occurred in Belgium in 1902, but they show that there were 870 outbreaks during this time. There is reason to believe that the actual cases were not so numerous as in the previous year of 1901, when there were 7,120. There was no report for tuberculosis; but when we remember that the average number of cases for the three years just previous was about 16,000, there are strong reasons for believing that the disease has not been eradicated. The number of cases of anthrax fell from 899 in 1901 to 329 in 1902.

Cases of contagious diseases of domestic animals in Belgium for the year 1902.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Glanders and farcy	14	6	4	5	4	13	2	2	2	7	1	1	61
Contagious pleuro-pneumonia	------	------	------	------	------	------	------	------	------	------	------	------	------
Foot-and-mouth disease (farm premises)	252	193	106	107	93	58	24	16	8	6	1	7	870
Rabies	1	------	------	1	2	4	15	1	1	1	------	2	27
Anthrax	36	21	19	26	27	27	32	43	28	26	21	23	329
Foot rot	------	------	12	125	3	8	15	------	7	18	------	------	------
Sheep scab	------	------	------	------	------	------	------	------	------	------	------	------	------
Tuberculosis	------	------	------	------	------	------	------	------	------	------	------	------	------

ITALY.

There was a marked increase in the number of cases of anthrax in Italy during the year 1902, there being 5,697 cases as against 2,500 in 1901. The reduction in the number of cases of foot-and-mouth disease from 274,396 in 1901 to 35,263 in 1902 is a gratifying condition. There was a slight increase in rabies, glanders and farcy, and hog cholera, but a decrease in scab. There was an increase of 17,079 of agalassia.

Cases of contagious diseases of animals in Italy during the year 1902.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.
Contagious pleuro-pneumonia						
Anthrax	96	62	2,074	525	204	86
Blackleg	13	10	16	13	31	26
Foot-and-mouth disease	6,404	3,435	4,780	3,199	5,226	3,514
Tuberculosis	16	15	17	17	22	9
Glanders and farcy	49	54	54	55	44	34
Sheep pox		35	27		13	
Rabies	36	47	26	65	65	23
Scab	2,255	413	4,096	1,681	1,933	4,711
Maladie du coït						
Hog cholera and swine plague	515	695	2,554	1,777	3,096	1,277
Barbone of buffalo	44	36				115
Agalassia contagiosa (of sheep and goats)	25	35	340	4,147	424	3,082

Name of disease.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Contagious pleuro-pneumonia				1			1
Anthrax	237	468	636	900	132	177	5,697
Blackleg	49	53	63	28	30	18	350
Foot-and-mouth disease	4,103	2,382	727	450	333	710	35,263
Tuberculosis	8	21	9	14	19	19	186
Glanders and farcy	45	35	23	26	34	40	493
Sheep pox			176	24	109	25	409
Rabies	20	41	25	18	25	37	428
Scab	1,838	2,000	4,216	200	3,008	2,270	30,421
Maladie du coït						1	1
Hog cholera and swine plague	1,856	3,766	1,103	778	944	749	19,110
Barbone of buffalo		68	33				296
Agalassia contagiosa (of sheep and goats)	8,502	8,574	910	524	710		27,273

DENMARK.

About the only change in the status of contagious diseases of animals in Denmark from 1901 was in reference to anthrax and malignant catarrhal fever. The number of cases of anthrax in 1902 was 150, while there were but 69 in the previous year. There were 102 cases of malignant catarrhal fever in 1902, while in 1901 there were only 71. No cases of foot-and-mouth disease have been recorded since January, 1901, and only one case then. There appear to be no sheep diseases of a contagious nature.

Outbreaks of contagious diseases among domestic animals in Denmark for the year 1902.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Anthrax	5	13	11	19	23	4	7	5	6	16	20	26	150
Foot-and-mouth disease	...	...	...	...	...	...	...	...	...	...	...	...	...
Sheep pox	...	...	...	...	...	...	...	...	...	...	...	...	...
Foot rot of sheep	...	...	...	...	...	...	...	...	...	...	...	...	...
Sheep scab	...	...	...	...	...	...	...	...	...	...	...	...	...
Cerebro-spinal meningitis	4	...	8	5	3	2	2	1	6	1	...	2	34
Glanders	...	...	...	...	...	...	...	2	1	2	...	...	5
Malignant catarrhal fever	5	7	3	15	14	17	11	12	11	...	3	4	102
Contagious pleuro-pneumonia	...	...	...	...	...	...	...	...	...	...	...	...	...
Cattle plague	...	...	...	...	...	...	...	...	...	...	...	...	...
Hog cholera or swine plague	2	2	10	13	18	5	10	13	12	14	3	8	110
Rouget:													
Acute	16	18	21	15	28	19	36	36	52	46	44	17	348
Chronic	18	11	8	3	1	5	5	10	11	16	26	18	132
Nodular erythema	74	66	88	62	59	97	252	326	508	318	214	89	2,153

NETHERLANDS.

The reports of Netherlands with reference to foot-and-mouth disease are encouraging. The disease became a scourge there in 1899, when there were 119,992 cases during the year. In 1900 there were 40,246 in eight months. Although this Bureau has not received reports for June and July, 1902, there is cause to believe that the scourge will soon be eradicated. The number of cases for the ten months for which we have reports was but 900. Other diseases prevailed to about the same extent as in 1901.

Cases of contagious diseases of animals in Netherlands for the year 1902.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Cattle plague	...	...	...	...	...	...	...	...	...	...	...	...	...
Contagious pleuro-pneumonia	...	...	...	...	...	...	...	...	...	...	...	...	...
Foot-and-mouth disease	321	132	109	60	241	...	...	15	14	...	...	8	900
Glanders and farcy	3	3	5	1	5	...	...	...	1	...	...	...	18
Sheep scab	169	94	296	73	178	...	...	436	216	236	374	177	2,249
Sheep pox	...	...	...	...	...	...	...	...	...	...	...	...	...
Foot rot of sheep	43	10	94	25	8	...	...	44	62	117	74	50	527
Rouget	13	10	14	11	23	...	...	175	219	86	49	21	621
Trichinosis	...	...	...	...	...	...	...	...	...	...	...	...	...
Anthrax	39	33	23	42	22	...	...	34	30	15	22	59	319
Rabies	...	...	...	...	...	...	...	...	...	...	...	1	1

NORWAY.

In Norway in 1902 the number of cases of anthrax was 537, an increase of 70 over the previous year of 1901. There was also an increase of malignant catarrhal fever, the number of cases in 1902 being 370, and 273 in 1901. The number of cases of rouget in 1902 was 1,476, in 1901, 1,218, an increase of 258. No cases of pleuro-pneumonia or foot-and-mouth disease were reported for Norway.

Cases of diseases of domestic animals reported in Norway for the year 1902.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Anthrax	37	44	46	44	86	47	58	15	37	32	44	47	537
Blackleg	------	1	1	------	3	3	3	5	2	2	1	1	22
Braxy	7	3	14	7	5	3	------	------	------	18	10	8	75
Malignant catarrhal fever	29	21	41	41	39	34	43	23	26	29	20	26	372
Rouget	42	27	53	43	75	67	149	120	347	258	191	104	1,476
Hog cholera	------	------	------	------	------	------	------	37	5	4	3	26	75

SWEDEN.

Outbreaks of contagious diseases of domestic animals in Sweden for the year 1902.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Anthrax	12	------	13	25	35	26	24	13	14	9	9	19	199
Emphysema infectiosum	1	------	1	2	2	1	6	2	11	6	2	2	36
Swine diphtheria	------	------	------	1	1	1	2	2	1	1	1	1	11

NEW ZEALAND.

The information contained in this statement is from the Report for 1900–01 of the Division of Veterinary Science, of the New Zealand Department of Agriculture, by J. A. Gilruth, M. R. C. V. S., principal veterinary officer, and his assistant, C. J. Reakes, M. R. C. V. S.

ANTHRAX.

Two outbreaks of anthrax occurred in Taranaki, "and both traceable, as in the case of those discovered last year, to the use of 'green-bone' manure. The first outbreak began with a cow on a turnip paddock of 10 acres. Altogether 3 cows, 4 dogs, and 2 pigs died from this outbreak. The turnips were sown with a mixture of basic slag and green-bone manure." The second outbreak occurred on a turnip field which had received green-bone manure. One cow died of anthrax from this outbreak.

SWINE FEVER.

Five districts suffered from the ravages of swine fever, namely, Palmerston North, Nelson, Wanganui, Auckland, and Mataura. The recrudescence of the disease at the place last mentioned above compelled the enforcement of strong measures. The hogs on the infected farms were all killed off and the place "will be absolutely prohibited to pigs for two years at least." Dr. Gilruth says: "We may almost hope that the last case of the disease has disappeared from the colony."

TRICHINOSIS.

Trichinosis, says Dr. Gilruth, is not known in New Zealand, and, so far as he is aware, not in any part of Australasia.

TUBERCULOSIS.

The tuberculin test has been applied to herds whenever request is made, but a beginning was made in the direction of a thorough and systematic inspection of dairy cows supplying milk to the large cities and boroughs in the colony. A careful clinical examination was made and those animals found to be tuberculous were at once condemned and the test applied to the doubtful or suspicious cases. Most dairymen welcome the inspection. A large number of tuberculous cattle have been destroyed.

Attention is directed to the fact that hogs fed on the by-products of dairy factories, and more especially offal from slaughterhouses, are frequently found to be tuberculous.

> The experience of the veterinary officers of this department (who can speak with some authority, seeing the large number of cattle annually tested by them) is, as heretofore, that tuberculin is a particularly reliable and trustworthy agent in the diagnosis of tuberculosis. It is not absolutely infallible, but when properly prepared and carefully administered, the percentage of cases in which it is found to be a failure is so small as to detract in no appreciable degree from its value.

The following table shows the number of cattle and hogs examined for tuberculosis, the number found affected, and the percentage at the four meat-export slaughterhouses. The figures, presumably, are for the period of a year:

Number of animals examined for tuberculosis, number found affected, and percentage.

Animals.	Number examined.	Number condemned for tuberculosis.	Percentage.
CATTLE.			
I	3,189	107	3.24
II	6,698	161	2.33
III	12,292	280	2.24
IV	3,511	122	3.11
HOGS.			
I	998	27	2.70
II	804	3	.37
III	1,393	40	2.86
IV	5,689	8	.14

ACTINOMYCOSIS.

"A number of cases of actinomycosis among cattle" were reported. Accounts are given of a few cases presenting special features of interest, among which was the case of an affected sheep.

VALUE OF ANIMALS SOLD AND SLAUGHTERED ON FARMS IN 1899.

The census reports of 1899 relative to live stock give the value of the animals sold off the farm (less any number that may have been purchased for the farm) and the value of those slaughtered on the farm. These figures do not include poultry and poultry products.

Only the total values of the animals sold and slaughtered are given; no attempt is made to show how many of each species of animal was sold or slaughtered. Reports of previous censuses do not give even this much. The census report for 1889 states that the number of cattle sold from the farm, including the number slaughtered on the farm, was 13,015,775. The number reported slaughtered was 1,294,237. No estimates for other animals are given for that year. As the one census gives values for all animals and the other gives numbers for cattle alone, there can, of course, be no satisfactory comparison.

The table herewith shows that the value of animals sold off the farm in 1899 was $722,913,114, and the value of animals slaughtered was $189,873,310, the total value being $912,786,424. The live-stock States stand out prominently. We find that the four States of Iowa, Illinois, Kansas, and Missouri sold $300,000,000 worth, being about two-fifths of the total. Add to these States the value of animals sold in Ohio, Nebraska, and Indiana, we have seven States, all in a body, furnishing considerably over half of the meat supply of the country.

The great position occupied by the State of Iowa is worthy of special mention. Her value of animals sold and slaughtered was $121,527,461. This was but $35,000,000 less than the total value for all the 21 States, including the District of Columbia, south and east of the Ohio River and east of the Mississippi River.

It is noticeable that in nearly all of the Southern States the value of animals sold does not equal the value of those slaughtered on the farm. If it were possible to estimate the value of the meat consumed in these States which was produced outside of them it would no doubt go far toward offsetting the value of that sold off the farms, and this would mean that the Southern States scarcely produce meat sufficient for their own consumption. While the conditions obtaining there are such as will probably never enable them to equal the States of the central Mississippi Valley in the production of live stock, there are evidences of increased interest in live stock, and we may believe that it will not be many years before the Southern States will make live-stock raising an important feature of their farm operations.—G. F. T.

	Sold.	Slaughtered on farms.	Number of farms. [a]	Acres in average farm.	Value of animals sold and slaughtered per farm.
Alabama	$1,958,640	$5,189,443	223,220	92.7	$32.02
Arizona	2,908,745	296,013	5,809	333	551.68
Arkansas	3,752,843	4,927,481	178,694	93.1	48.01
California	13,305,165	2,449,820	72,542	397.4	217.10
Colorado	8,477,587	1,093,365	24,700	383.6	387.47
Connecticut	1,169,235	845,123	26,948	86	74.75
Delaware	396,264	424,400	9,687	110	84.72
District of Columbia	475	2,440	269	32	10.84
Florida	830,657	1,257,648	40,814	106.9	51.17
Georgia	1,689,615	5,892,046	224,691	117.15	33.74
Hawaii	298,476	64,081	2,273	1,148	159.50
Idaho	3,909,454	626,237	17,471	183.4	259.61
Illinois	69,462,993	10,154,596	264,151	124.2	301.41
Indiana	40,865,661	8,016,595	221,897	97.4	220.29
Indian Territory	6,415,707	1,557,139	45,505	159.7	175.21
Iowa	113,078,523	8,448,938	228,622	151.2	531.56
Kansas	64,596,534	5,864,274	173,098	240.7	407.05
Kentucky	16,660,676	8,198,080	234,667	93.7	105.93
Louisiana	1,072,869	1,929,437	115,969	95.4	25.89
Maine	2,371,717	1,258,594	59,299	106.2	61.22
Maryland	2,372,560	2,173,197	46,012	112.4	98.75
Massachusetts	1,284,454	932,411	37,715	83.4	58.78
Michigan	18,343,856	5,333,786	203,261	86.4	116.49
Minnesota	16,046,622	4,908,051	154,659	169.7	135.49
Mississippi	2,208,466	4,818,416	220,803	82.6	31.82
Missouri	54,018,809	9,765,879	284,886	119.3	223.89
Montana	9,176,830	906,816	13,370	885.9	754.20
Nebraska	49,022,404	4,508,457	121,525	246.1	440.58
Nevada	2,260,221	270,228	2,184	1,174.7	1,158.63
New Hampshire	1,345,941	794,342	29,324	123.1	72.99
New Jersey	1,638,767	1,406,187	34,650	82	87.88
New Mexico	3,740,678	605,296	12,311	416.8	353.01
New York	15,025,932	8,319,750	226,720	99.9	102.53
North Carolina	2,485,252	7,109,655	224,637	101.3	42.71
North Dakota	3,902,074	1,573,588	45,332	342.9	120.79
Oregon	6,598,325	1,565,895	35,837	281	227.81
Ohio	40,873,674	10,276,931	276,719	88.5	184.85
Oklahoma	10,547,764	2,925,846	62,495	251.5	215.59
Pennsylvania	15,494,178	11,627,980	224,248	86.4	120.95
Rhode Island	157,478	142,824	5,498	83	54.62
South Carolina	823,554	2,730,079	155,355	90	22.87
South Dakota	12,707,831	1,567,049	52,622	362.4	271.27
Tennessee	11,121,141	8,350,046	224,623	90	86.68
Texas	34,357,265	11,032,614	352,190	357.2	128.88
Vermont	2,786,137	1,347,754	33,104	142.7	124.87
Utah	2,695,504	659,369	19,387	212.4	173.05
Virginia	7,800,124	5,859,531	167,886	118.6	81.36
Washington	3,517,053	1,168,802	33,202	256	141.13
West Virginia	6,533,034	2,895,032	92,874	114.7	101.51
Wisconsin	27,131,916	5,407,114	169,795	117	191.63
Wyoming	3,673,124	394,635	6,095	1,333	667.40
Total	722,913,114	189,873,310	5,739,645		

[a] This column gives the total number of farms in the States and Territories. The number of farms reporting animals sold was 3,024,962; the number reporting animals slaughtered was 4,124,273.

SOME AGRICULTURAL EXPERIMENT STATION WORK.[a]

By GEORGE FAYETTE THOMPSON, M. S., and JOHN ROBERTS,
Editorial Office, Bureau of Animal Industry.

HORSE FEEDING.

[LEWIS A. MERRILL, Bulletin No. 77, Utah Agricultural Experiment Station.]

LUCERN VERSUS TIMOTHY FOR HORSES.

A series of experiments to determine the relative values of lucern (alfalfa) and timothy hay for horses was conducted at the station at Logan, Utah, during 1899, 1900, and 1901. The value of lucern as a feed had been demonstrated by previous experiments at this station, but, while there seemed to be no objection to feeding it to cattle, sheep, and hogs, there was a prejudice in some quarters against feeding it to horses. It was stated by some of these objectors that it was too strong a diuretic to be fed for a very long period, and by others that its constant feeding to horses occasioned heaves. The following is a brief account of each experiment:

Experiment I.—The first test was commenced January 13, 1899, and continued thereafter for 95 days. Four horses were used; Billy and Nig, grade Shire geldings, aged 7 and 12 years, respectively, composed one team; and King and Prince, grade Clydesdales, 6 and 5 years old, respectively, composed the other. One horse in each team was fed on lucern hay, with grain, and the other on timothy hay, with grain. The whole ration consisted of 25 pounds of hay and 10 pounds of grain, consisting of bran and shorts, per day to each animal. Most of the hay was fed at night, and more grain and less hay was fed at noon. The teams worked every day at ordinary farm work.

It will be noticed that the horses fed on lucern lost between them only 4 pounds in weight, while those fed on timothy lost 124 pounds. The reason that Nig and Billy made the poorest showing for the respective feeds, it is stated, was because this pair during the last week of the test had exceptionally hard work to do.

The cost of feeding is also much in favor of the lucern pair. The latter each cost on an average a little under 10 cents a day, while the timothy pair averaged over 12 cents each. The cost figures are based on the prices prevailing at the time, namely, \$6 per ton for timothy, \$4 per ton for lucern, and 50 cents per hundredweight for the grain.

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

Comparative results of feeding horses on lucern and timothy.

	Lucern.		Timothy.	
	Prince.	Nig.	King.	Billy.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Weight January 13, 1899	1,326	1,438	1,432	1,412
Weight April 19, 1899	1,330	1,430	1,385	1,335
Gain (+) or loss (−) in 95 days	+4	−8	−47	−77
Total hay eaten	2,354	2,301	2,311	2,274
Total hay not eaten	21	74	79	101
Total grain eaten	950	950	950	950
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*
Total cost of food	9.46	9.35	11.68	11.57
Cost per day	.099	.098	.124	.122

Experiment II.—In order to make the comparison as searching as possible, several other tests were made under varying conditions. The second was entered upon immediately after the first, but with the order of things reversed. The same quantity of hay and grain was given each horse, but the animals formerly fed on lucern were now given timothy, and vice versa.

Comparative results of feeding horses on lucern and timothy.

	Lucern.		Timothy.	
	King.	Billy.	Prince.	Nig.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Weight April 19, 1899	1,385	1,335	1,330	1,430
Weight June 15, 1899	1,435	1,360	1,335	1,365
Gain (+) or loss (−) in 56 days	+50	+25	+5	−65
Total hay eaten	1,387	1,394	1,258	1,297
Total hay not eaten	13	6	142	103
Total grain eaten	560	560	560	560
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*
Total cost of food	5.59	5.60	6.57	6.69
Cost per day	.099	.099	.117	.119

The result confirms the previous experiment in every respect. The lucern-fed horses made striking gains as compared with the others, although Prince, one of the horses fed on timothy, rather more than held his own. In the first experiment he was the only horse that showed a gain. It may be noted that the animals fed lucern cleaned up their hay much better than the other pair. The cost of the feed per day comes out practically the same as in the first experiment, namely, 10 cents per animal for the horses fed on lucern and 12 cents for those fed on timothy.

While the weights given show in part the effect of lucern as compared with timothy when fed to horses, the whole effect can not be shown. Horsemen interested in the horses belonging to the Experiment Station made inquiries of the

teamsters as to the cause of the raw-boned condition of the timothy-fed horses after a few weeks' feeding on that crop. The lucern-fed horses at the close of each feeding period presented a sleek, well-fed condition, and the flesh, though not so firm to the touch as the timothy-fed horses, presented a much better appearance to the casual observer. The teamsters did not notice any particular effect of the feed on the willingness of the horses to do work, though they were agreed, that if they could have their choice, they would much prefer to feed lucern.

Experiment III.—The horses were again changed, so that they were the same as in the first experiment. The feeding was similar to the preceding trials, except that a fixed amount of grain was not, as before, given. The grain for this experiment (which extended over 91 days) averaged 12 pounds per day for each animal, and was eaten clean, as in all the other tests. The same amount of hay was fed as before, namely, 25 pounds per horse per day.

Comparative results of feeding horses on lucern and timothy.

	Lucern.		Timothy.	
	Prince.	Nig.	King.	Billy.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Weight November 20, 1899	1,350	1,391	1,440	1,391
Weight February 20, 1900	1,400	1,400	1,440	1,370
Gain (+) or loss (−) in 91 days	+46	+9	----------	−41
Total hay eaten	2,239	2,219	2,152	2,183
Total hay not eaten	36	56	123	172
Total grain eaten	1,105	1,120	1,105	1,120
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*
Total cost of food	10.00	10.04	11.99	11.97
Cost per day	.109	.11	.132	.132

It will be seen that there were no essential variations from the previous experiments. The horses fed on lucern made the usual gains, and while one of the timothy-fed animals came out even, the other lost 41 pounds. Neither was there any change in the relative cost per day, the figures showing, as before, 2 cents per horse per day in favor of the lucern; but owing to the greater quantity of grain consumed there was a uniform advance in cost of 1 cent per day for all the horses.

Experiment IV.—After another change of horses, the same conditions of feeding were observed as heretofore. The grain was again increased, however, the quantity this time averaging 14½ pounds per horse per day.

The accompanying table shows the same results as all the preceding ones. It will be seen that the horses fed on lucern gained in the aggregate 65 pounds, while those on timothy lost 100 pounds. The superior appetite of the lucern pair is noticeable, a greater amount of hay being consumed by them. It will be seen also that they practically cleaned up all that was fed to them, while the timothy pair refused a large quantity. The relative cost was as before in favor of lucern, but not

so much so as in the three previous experiments; the difference on this occasion averaged a shade over $1\frac{1}{2}$ cents per horse per day, whereas before it had been fully 2 cents.

Comparative results of feeding horses on lucern and timothy.

	Lucern.		Timothy.	
	King.	Billy.	Prince.	Nig.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Weight February 20, 1900	1,440	1,350	1,400	1,400
Weight April 30, 1900	1,465	1,390	1,360	1,340
Gain (+) or loss (−) in 68 days	+25	+40	−40	−60
Total hay eaten	1,699	1,698	1,551	1,451
Total hay not eaten	1	2	149	249
Total grain eaten	993	990	993	990
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*
Total cost of food	8.36	8.35	9.62	9.30
Cost per day	.123	.123	.141	.137

Experiment V.—All the horses at the station were pressed into service for this experiment. The additional animals were Cap and Maud, the light college team, used for hauling freight, driving, etc.; and Jack and Totum, general-purpose horses, the former the carriage horse of the director of the station, and the latter used for carrying mail, etc. Cap is a gelding, 8 years old; Maud is aged 7, and Jack is 9 years old; the age of Totum is not mentioned.

Oats was now substituted for bran and shorts, and a less quantity of food given throughout the test—particularly of hay. At the commencement the four heavy horses—King, Billy, Prince, and Nig—received 15 pounds of hay each per day, and the four light ones—Cap, Maud, Jack, and Totum—12 pounds. Of the oats, the heavy horses were each given 12 pounds per day and the others 9 pounds each. These quantities were fed daily until February 17, 1900, when an increase was made in both hay and grain.

Comparative results of feeding horses on lucern and timothy.

	Lucerne.				Timothy.			
	Prince.	Nig.	Cap.	Totum.	King.	Billy.	Maud.	Jack.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Weight Nov. 1, 1900	1,395	1,362	1,115	1,090	1,432	1,392	1,100	1,130
Weight Apr. 30, 1901	1,360	1,395	1,115	1,100	1,400	1,315	1,060	1,090
Gain (+) or loss (−) in 180 days	−35	+33		+10	−32	−77	−40	−40
Total hay eaten	3,045	3,021	2,063	2,454	3,045	3,040	1,862	2,489
Total hay not eaten		24	339	54		5	581	19
Total grain eaten	2,370	2,370	1,740	1,619	2,370	2,370	1,928	1,804
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
Total cost of food	27.44	27.39	19.79	19.48	30.46	30.45	22.94	23.70
Cost per day	.152	.152	.109	.108	.169	.169	.127	.133

There is an aggregate gain of 8 pounds by the lot fed on lucern, and a loss of 189 pounds by the timothy lot. The moderate amount of hay fed brought the waste down to a minimum, except in the case of the driving pair, Cap and Maud, and the reason that the latter wasted so much was that they were not, like the others, worked continuously.

One of the points brought out by the experiment is that while $2 more per ton was paid for the timothy, the total cost of keeping the four timothy-fed horses for the six months was but $13.45 more than the lucern-fed horses; if we take into account the 373 pounds of oats eaten by the two timothy-fed driving horses in excess of the two lucern-fed driving horses, the extra cost of feed is reduced to $10.09.

As will be seen from the table, the cost of maintenance was greater during this period than during the previous periods. This was due to the fact that oats formed a part of the ration. The price charged for the oats [90 cents per cwt.] is the average cost for the past several years, though the cost at present writing is 40 cents per hundred higher than the price given. Had enough oats been fed to keep the weight of the timothy-fed horses constant, the cost of maintenance would undoubtedly have been greater.

The results of the tests, under varying conditions of work, are so uniform that the value of lucern when fed to horses may be regarded as quite definitely established. It did not seem a difficult matter to maintain the weights of horses on lucern when given the same amount as was given to the timothy-fed horses. No ill effects were noted on the general health of the horses, and the appearance of the lucern-fed hores certainly contrasted favorably with those which received timothy.

IS TOO MUCH COARSE FODDER FED TO HORSES?

It would seem from close observation at this station that it is undoubtedly true that too much coarse fodder is fed to horses. It were well, therefore, for stockmen and other interested persons to give the matter close attention.

The stomach of the horse is very different from that of the ruminant animals, such as the cow. The latter has in reality four stomachs, unless it be more correct to say four divisions of one stomach. The horse has but one sac, and the process of digestion is therefore simple and direct. As might be inferred from the foregoing, the capacity of a cow's stomach is very much larger than that of a horse. The following comparison of the stomach and intestines of the horse and cow is taken from "Feeds and Feeding," by W. A. Henry:

	Horse.	Cow.
	Quarts.	*Quarts.*
Average capacity of stomach	19	266.9
Average capacity of small intestines	67.4	69.7
Average capacity of large intestines	137.4	40.1
	Feet.	*Feet.*
Average length of small intestines	73.6	150.9
Average length of large intestines	24.5	36.3

The capacities here indicated would naturally suggest to the feeder the inadvisability of gorging the comparatively small stomach of a horse with hay or other roughage.

Experiments have been made which show that horses have a "uniformly lower digestive efficiency than ruminants." The horse dissolves less crude fiber than the steer or sheep, and this peculiarity is more marked in the case of the crude fiber of fodder crops than in the grains. These considerations led us to the conclusion that too much hay was being fed at the station barn.

From weighings made of the amount of food fed before the experiments in horse feeding were begun, it was found that the draft horses were receiving from 35 to 40 pounds of hay per day in addition to 12 to 15 pounds of bran and shorts. One of the horses (Nig) had frequent attacks of flatulent colic, and occasional and somewhat serious attacks were noted with two of the others These attacks usually occurred on Monday, after the horses had been idle Sunday, but began work engorged with food. Since a more rational system of feeding has been adopted (the amount of hay fed being reduced from [by] 10 to 12 pounds) there has not been a single case of digestive disorder in the barn.

It is folly to claim that a horse will not eat more than is necessary if allowed the liberty of the stack and the grain bin. The argument is sometimes made that a horse under natural conditions, on pasture, never eats more than is necessary, and that under these conditions he is never subject to digestive disorders. While this is undoubtedly true, it must be kept in mind that as soon as we stable the horse and require work of him we have taken him away from his natural condition and placed him under unnatural environments. Thousands of dollars and many valuable horses could be saved annually in Utah if the amount of coarse fodder fed horses could be reduced one-half.

RELATIVE VALUES OF OATS AND BRAN AND SHORTS.

The results of the feeding of these rations would tend to show that it is practically immaterial whether the coarse fodder is combined with oats or with bran and shorts, the one being equally as satisfactory as the other.

It is evident from the study of the experiments, during four periods of which bran and shorts were used and during one when oats made up the grain ration, that bran and shorts may be substituted for the oats when the horses are fed either lucern or timothy.

The tables, in fact, reveal a gain with lucern and bran and shorts with practically no exception. With lucern and oats there was neither a gain nor a loss. Where timothy was fed there was invariably a loss, but no difference is noted in the effect when combined with oats, or with bran and shorts. Usually the cost of maintaining horses can be very materially reduced by using bran and shorts, for oats, as a rule, are comparatively more expensive than other grains.

THE DIURETIC EFFECT OF LUCERN ON HORSES.

The statement has been made in a prominent stock paper that it is "absolutely cruel to maintain a horse exclusively on this forage (lucern)." The reason given was that it was so strong a diuretic as to be an unsafe food. But the experience of the writer does not coincide with this view.

Lucern has formed the sole fodder ration of all the horses belonging to the experiment station from the beginning, twelve years ago, except when, for brief

periods, they have been fed experimentally on other forage. The station has never lost a horse, either directly or indirectly, from lucern feeding. Neither has there ever been any inconveniences noted as a result of excessive urination. True, observations have been made that horses on lucern excreted more urine than on other feeds, but not enough more to cause any inconvenience. However, to test this matter, the question was considered of sufficient importance to form the basis of careful experimentation.

A special harness was devised for the purpose of the test, by which all the urine passed by the horses was collected, whether they were at work or in the stable. The experiment was also designed to distinguish between three conditions of lucern—namely, early cut, medium cut, and late cut of the first crop—and timothy. Records were kept in the case of each horse of the quantity of hay eaten, the water consumed, and the urine excreted.

The results obtained were in accordance with the opinions previously expressed. The horses, while eating lucern, excreted considerably more urine than those on timothy, but they also drank fully 10 per cent more water than the latter, so the difference is not so great as it may seem at a casual glance. The averages of the water consumed and the urine excreted for all the periods of the experiment were as follows:

	Lucern.	Timothy.
	Pounds.	*Pounds.*
Daily consumption of water per horse	91	82
Daily excretion of urine per horse	27	16

In regard to the qualities of lucern, it was found that the greatest excretion of urine took place while feeding the early cut lucern, and the least while feeding the late cut.

CONCLUSIONS.

(1) In comparing lucern and timothy as roughage for horses the results of six tests under varying conditions of work show that it is not as difficult to maintain the weights of horses when fed lucern as when fed timothy.

(2) The cost of maintenance was greater in every case, except one, on timothy than on lucern.

(3) The appearance of the horses in every comparison of lucern and timothy was in favor of the lucern-fed horse.

(4) When lucern and timothy were fed ad libitum much greater quantities of lucern were consumed.

(5) No ill results were noted on the health of the horses by long-continued lucern feeding.

(6) Attacks of colic and other digestive disorders can be prevented by a judicious system of feeding. The amount of hay fed on most Utah farms could be reduced at least one-half. It may be economical to reduce the amount of hay and increase the amount of grain fed to horses.

(7) It is evident from a study of the experiments, during four periods of which bran and shorts were used and during one when oats made up the grain ration,

that bran and shorts may be substituted for the oats whenever the horses are fed lucern or timothy.

(8) Twenty pounds of lucern per day proved sufficient to maintain the weights of horses weighing nearly 1,400 pounds when at rest. When at heavy work, 32.62 pounds of lucern per day were barely sufficient to maintain the weights of the same horses.

(9) The greater consumption of water when horses are fed lucern results in a greater elimination by the kidneys, but we have no evidence that this greater elimination is in any way detrimental to the health of horses.

(10) From the tables it is evident that there is a tendency to use all of the protein when horses are fed timothy, and an apparent waste of nitrogen when horses are fed lucern. This waste is not considered serious here, as protein (nitrogen compounds) is not an expensive part of the diet.

(11) It would seem from the experiments conducted on the amount of water consumed by horses that the amount varies with the amount eaten, though further evidence is required to make this conclusive. In the experiments conducted the horses fed timothy ingested more water for each pound of dry matter eaten than the lucern-fed horses.

(12) The individuality of the animal is a potent factor both in food and water consumption.

In other words, one horse in a team doing similar work and on the same feed may eat or drink considerably more than the other.

PREVIOUS WORK ON HORSE FEEDING.

Time of watering horses.—In Bulletin No. 9 of this station Professor Sanborn reports a series of experiments conducted at the Missouri and at the Utah experiment stations on "Time of watering horses." While he does not consider the trials conclusive, he finds that horses watered before feeding grain retained their weight better than when watered after feeding grain. He advises, however, watering both before and after feeding, as a prior trial seemed to show "a small apparent advantage in favor of feeding after watering on digestion."

Whole v. ground grain for horses.—In the same bulletin an experiment on whole versus ground grain is reported. The experiment extended from May 25 to July 6. There was practically no difference in the weights of the horses fed on the whole or cracked grain. If the cost of grinding the grain is taken into consideration, ground grain would have to be from 15 to 20 per cent more effective than whole grain to make the process profitable. As there was practically no difference in the weights of the horses, the conclusion is reached that it does not pay to grind grain for horse feeding.

Horses covered with blankets versus not so covered.—In Bulletin No. 11, an experiment is reported on the effect of keeping horses continually blanketed. The experiment was conducted during a part of January and February, extending over a period of 42 days. It was found that blankets worn daily while at work proved a source of irritation to the horses. The conclusion was reached that horses wearing blankets beneath their harness in the day and blanketed in the stables at night do not hold their weight as well as those without blankets.

Feeding horses hay and grain mixed.—In 1891 two trials were made to determine if the generally accepted belief that hay and grain mixed are more effective than when fed separately is correct. The trials led to the conclusion that cutting

and mixing hay and grain is not a profitable practice. Professor Sanborn questions whether any physiological principle is involved.

Feeding cut hay versus whole hay to horses.—The practice of cutting hay for horses is also discussed in the same bulletin (No. 13). The reasons assigned for cutting hay are, first, that much of the labor of mastication is obviated when the hay is finely cut, and, second, that more complete mastication is the result of the practice, and through it more complete digestion. On the other hand, it is argued that cutting adds but slightly to the end sections of the hay and that mastication is far more effective than the square, sharp cut of a knife that merely shows a little more of the end section of the hay, while mastication is a trituration, a sort of imperfect grinding of the whole stem, and that when fed whole the hay is more slowly eaten and the gastric juice is more perfectly mixed with it. To test these theories an attempt was made to settle the question by a feeding test. Two lots of horses were used, each lot consisting of two work horses. From the experiments conducted it seems evident—

(1) That timothy hay cut into very short pieces makes the horses' mouths sore, and in consequence there results a falling off in weight. (As these results were not those of a direct trial, but the surface indications of an indirect trial, it may may be that the conclusion is not well founded.)

(2) That lucern and clover cut into very fine pieces results in a greater gain than uncut lucern and clover. The total gain for both periods of lot receiving cut lucern and clover was 174 pounds, and for the lot receiving whole hay 57 pounds.

Narrow versus wide nutritive rations for horses.—In the third annual report of this station (1892), and in Bulletin No. 30, the result of feeding wide and narrow nutritive rations to horses is given. The first trial was favorable to the narrow nutritive ration. The narrow ration was made up of clover, oats, and wheat, while timothy and corn made up the wide ration. This trial ran through the summer when the influence of what has been termed "heating food," like corn, might be less effective than in the winter season. The trial was repeated during the cold weather, the rations being reversed to determine the individual factor. The results of the latter experiment were favorable to the wider ration. The test shows that corn and timothy are superior to clover, timothy, and oats, notwithstanding the fact that the popular estimation of the value of these feeds leans strongly to the latter ration. It was found in this experiment that a small amount of protein—0.82 pound per day per horse—was as adequate for the horses as double the amount, thus showing that a very small amount of protein per day is sufficient for a working horse.

Relative value of corn and oats for horses.—The work instituted by Professor Sanborn of comparing wide with narrow nutritive rations led Professor Mills to conduct an experiment making a direct comparison of oats and corn as the principal grain ration for horses. From a review of all the tables presented it was found that after five months' feeding the horses on oats lost 47 pounds, while those on corn gained 29 pounds. (Bulletin No. 36.)

STEER FEEDING IN WINTER.

[D. O. Nourse, Bulletin No. 121, Virginia Experiment Station.]

It is often a question of importance to farmers and stock raisers how best to carry animals over the winter which are intended for fattening at a later period. The questions of shelter and feed—what proportion and what kind of roughage and what proportion and

what kind of grain, etc.—have to be closely studied to secure the best results from an economic point of view. An attempt was made to increase the stock of information on these matters by means of an experiment, the particulars of which are given below.

The "stockers" used in the experiment were divided into six lots of two steers in each. All were fed in the barn.

Table showing for each lot the kind of feed, the total gain, the average cost, and the cost per 100 pounds of gain.

Kind of feed.	Food consumed in 15 weeks.	Total gain in 15 weeks.	Average cost per week.	Cost per 100 pounds gain.
	Pounds.	*Pounds.*	*Dollars.*	*Dollars.*
Lot 1:				
Corn	1,147	140	1.27	13.52
Hay	1,208			
Lot 2:				
Corn meal	1,262	177.5	1.25	10.66
Hay	1,163			
Lot 3:				
Corn meal	1,262	108	.98	13.62
Stover	1,055			
Lot 4:				
Corn meal	1,262	172	1.14	9.92
Hay	531			
Silage	1,635			
Lot 5:				
Corn meal	840	125	1.24	14.84
Cotton-seed meal	315			
Hay	1,197			
Lot 6:				
Corn meal	630	196	1.18	9.02
Bran	630			
Hay	1,276			

The above figures of cost were based on prices of the different feeds as follows: Corn and corn meal, $20 per ton; bran, $16 per ton; cotton-seed meal, $25 per ton; hay, $10 per ton; stover, $4 per ton; silage, $2 per ton.

The several lots were given all they could eat of the roughage and 12 pounds of grain, except lot 5, which had 8 pounds of corn meal and 3 pounds of cotton-seed meal. Lot 6 had 6 pounds of corn meal and the same quantity of bran.

It should be mentioned that lot 5 had never eaten cotton-seed meal before and did not relish it. The results in this case would no doubt have been better had this portion of their feed been more palatable. The substitution of 2 pounds of bran for half of the cotton-seed meal used would probably have been a great improvement.

By comparing lots 1 and 2 it will be noticed that corn meal gave much better results than unground corn, both in the weight gained and the cost; but corn meal and hay were, in turn, exceeded by corn meal, bran, and hay, fed to lot 6, the latter coming out an easy first

in both quantity and value. The least gains were made by the stover lot, showing it to be an undesirable kind of roughage when used alone. The small amount of it eaten gives some idea also of the enormous waste which is caused by feeding in the open field, due to the feed being trampled into the ground or blown away by the wind.

Next to lot 6 the most economical feeding was that of lot 4, and this was without doubt because of the use of silage in the roughage. Silage is highly relished by all cattle and its use is strongly recommended. In this connection it may be said that a good silo need not necessarily be an expensive one. A pit in the ground without walls will answer the purpose if the earth around the silo is thoroughly dry; but the simple stave silo above ground is about as cheap and perhaps more satisfactory.

The following are some conclusions suggested by the experiment:

(1) A combination of foods, both grain and roughage, is best from every standpoint.

(2) Ground corn is better than whole corn after it [the latter] has become hard.

(3) A mixture of corn meal and bran gave greatest gain and with least expense per pound.

(4) Cotton-seed meal was not, in these experiments, used with success, due, at least in part, to the fact that in former years the steers had not become accustomed to it.

(5) Silage was a very economical addition to the roughage.

(6) Stover gave a bad showing when used without other roughage.

STALL FEEDING OF STEERS.

[Hiram T. French, Bulletin No. 32, Idaho Experiment Station.]

The following are the results of some tests made to ascertain the feasibility and economy of stall feeding of steers with products grown on the farm.

The steers used in the experiment were what are known as "long 2-year-olds." They were "common stock, with some Shorthorn blood, and some Jersey in the 2 which showed the poorest gains." There were 6 in all, divided into three lots of 2 each.

The animals were confined in stalls with a chain tie fastened to an iron rod on the side of the mangers. They were turned in the yard to water at 9 o'clock in the morning, and remained in yard until noon, except in very stormy weather. Water was supplied in a trough in the yard.

Preliminary to the feeding test the steers ran in a small field, and were fed on corn fodder from the shock. They were put in stalls a few weeks before the feeding began, to accustom them to their quarters and to being handled. It is surprising how soon wild steers will learn to keep quiet and go into their places in the stalls when handled quietly and persistently. * * * It requires a little tact, and much patience; but these qualities must be prominent in any successful feeder of live stock.

The total time consumed in the tests was eight weeks, commencing January 19, 1902, and ending March 16, 1902. Progress was reported every two weeks, thus dividing the time into four equal periods.

Barley and shorts seemed to agree with all the animals, and they all relished the combination. Attention is called to the fact that "the steers in lot 3 were not as good feeders as those in either of the other lots; and on account of this individual factor it is not safe to draw too close comparisons in the various lots fed." But it should be safe and instructive to study the detailed results of each period for the various lots, as given below:

LOT 1.

First period.—Food consumed: Hay, 148 pounds; grain, 224 pounds; silage, 812 pounds. The grain consisted of chopped wheat. The gain made in the two weeks was much heavier than in any of the later periods. It amounted to 105 pounds for the lot, which was equal to 1 pound for every 2.13 pounds of grain consumed.

Second period.—Food consumed was practically the same as in the first period and the same kind of grain, but there was a great falling off in the gain, the total being only 25 pounds, or 1 pound to 8.88 pounds of grain.

Third period.—Food consumed: Hay, 148 pounds; grain, 232 pounds; silage, 783 pounds. This time the grain consisted of one-half chopped wheat; the other half consisted of equal parts of chopped rye and bran. The gain during this period was 35 pounds, or 1 pound to 6.63 pounds of grain.

Fourth period.—Food consumed: Hay, 147 pounds; grain, 278 pounds; silage, 840 pounds. A complete change of grain was given this time, the ration consisting of chopped barley and shorts in equal proportions. The gain for the period was 70 pounds, equal to 1 pound to 3.97 pounds of grain.

This was thought to be as good a showing as was made in localities where corn was the basis of the grain ration.

The roughage fed consisted of hay made from mixed grasses and clover, and corn silage, the latter containing very little grain.

LOT 2.

First period.—Food consumed: Hay, 174 pounds; grain, 174 pounds; silage, 473 pounds. The grain was the same as for lot 1 for the same period—chopped wheat. These steers were not quite as heavy feeders as those of lot 1, but the gain made was large and economical, the total being 85 pounds, which was the equivalent of 1 pound to 2.05 pounds of grain—the best in the whole series.

Second period.—Food consumed: Hay, 204 pounds; grain, 204 pounds; silage, 513 pounds. The grain was the same as before. The

feeding was a little heavier than in the first period, but the gain was much less, although not so heavy a slump as was the case in the second period with lot 1. The total gain was 45 pounds, equal to 1 pound for 4.53 pounds of grain.

Third period.—Food consumed: Hay, 184 pounds; grain, 184 pounds; silage, 462 pounds. The grain fed consisted of the same varieties as given to lot 1, but in different proportions, the latter being in this case three parts chopped rye, one part bran, and one part chopped wheat. There was evidently too much rye in the ration, as the result for the period was a far worse failure than it was for the second period with lot 1. The total gain was only 15 pounds, or 1 pound to 12.27 pounds of grain.

Fourth period.—Food consumed: Hay, 194 pounds; grain, 174 pounds, and silage 490 pounds. It will be observed that there was more hay and less silage than in the other cases; the grain was chopped barley and chopped wheat, in equal parts. The result was very satisfactory, the total gain being 55 pounds, or 1 pound to 3.17 pounds of grain.

LOT 3.

First period.—Food consumed: Hay, 119 pounds; grain, 250 pounds, and silage 950 pounds. An effort was made with this lot to feed as much silage as possible, with a short ration of hay. The grain consisted of 2 parts chopped wheat and 1 part of bran. The total gain was 40 pounds, equal to 1 pound to 6.25 pounds of grain.

Second period.—Food consumed: Hay, 140 pounds; grain, 260 pounds, and silage 944 pounds. The grain was the same as in the first period, but, while a little more was consumed, the total gain was 10 pounds less, or altogether 30 pounds, equal to 1 pound to 8.67 pounds of grain.

Third period.—Food consumed: Hay, 110 pounds; grain, 247 pounds; silage, 887 pounds. The grain was one-third each of chopped wheat, rye, and bran. The results were very similar to those of the previous two weeks, the total gain being the same, and the grain equivalent, 8.23 pounds.

Fourth period.—Food consumed: Hay, 120 pounds; grain, 220 pounds; silage, 941 pounds. Barley and shorts were given the same as for the other lots, and the steers did very much better than in any of the previous periods, although not so well as the other lots did. The total gain for the period was 50 pounds, or 1 pound to 4.40 pounds of grain.

	Lot 1.	Lot 2.	Lot 3.
	Pounds.	*Pounds.*	*Pounds.*
Weight at beginning	2,170	1,830	2,000
Weight at close	2,405	2,030	2,150
Total gain, 56 days	235	200	150
Average gain per head	117.5	100	75
Daily gain per head	2.10	1.78	1.38
Grain consumed	953	732	977
Hay consumed	591	742	489
Corn silage	3,235	1,938	3,722
Grain eaten for pound gain	4.05	3.66	6.51
Hay eaten for pound gain	2.51	3.71	3.26
Silage eaten for pound gain	13.72	9.69	23.61
	Dollars.	*Dollars.*	*Dollars.*
Cost of food for 100 pounds gain [a]	4.39	4.39	7.05
Total cost of food	10.32	8.78	10.57
Original cost of steers	60.00	60.00	60.00
Selling price of steers [b]	102.21	96.42	101.82
Increase over cost	42.21	36.42	41.82
Net profit above cost of feed	31.89	27.64	31.25

[a] Grain valued at $13.50 per ton; hay valued at $5 per ton; silage valued at $1.50 per ton.
[b] Steers sold for $4.75 per 100 live weight.

CONCLUSIONS.

(1) On the whole, the feeding was profitable in all the steers, showing a net average increase for 56 days' feeding of $15.13 per head.

(2) The barley-shorts and the barley-chopped-wheat combinations constitute an excellent grain ration for steers.

(3) The chopped rye was not especially well relished by the steers.

(4) Chopped wheat alone is a good grain ration when combined with corn silage and hay.

(5) That the conditions in this locality, so far as affected by climate and food supply, are favorable for stall feeding of cattle.

FATTENING BEEF CATTLE.

[R. S. SHAW, B. S. A., Bulletin No. 31, Montana Experiment Station.]

The possibility of successfully fattening steers in Montana had previously been demonstrated, and an account of the experiment was published in Bulletin No. 27 of the Montana Station. Numbers of cattle are raised on the ranges of the State, but these, of course, all mature at the same season of the year and have then to be shipped immediately because of scanty food supplies. Thus the local wants of the State for the other parts of the year are neglected. This state of affairs, however, need not continue. Many of the large stock owners do, in fact, supply their flocks and herds during the winter with food, and there is no good reason why the farmers of this region should not supply the local demand at all times, and ship live stock

out of the State in addition. The farmers are able to raise forage in unlimited quantities, and no better use can be made of it than to turn it into beef and mutton.

The animals used in the present experiment numbered 31, namely, 11 steers which had been grazing on clover at the station farm during the summer and 20 others procured from the range. They were all yearlings—Shorthorn grades, excepting one or two showing Hereford blood. The steers were divided into three lots, according to quality. Lot 1 consisted of the 11 pastured animals and lots 2 and 3 of the range animals (10 in each). The latter were in much poorer condition than lot 1, owing to feed on the range having been scarce; and as regards the quality lot 1 "showed the largest infusion of beef blood, lot 2 was a close second, and lot 3 was the least typical."

The feeding test commenced November 13, 1900, and finished March 30, 1901, a period of 137 days.

Table of experiment.

		Lot 1 (11 steers).	Lot 2 (10 steers).	Lot 3 (10 steers).
		Pounds.	*Pounds.*	*Pounds.*
Average weight per head November 13, 1900		823.60	798.50	737.50
Average weight per head March 30, 1901		1,097.70	1,039.50	972
Average gain per head in 137 days		274	241	234.50
Average daily gain per head		2	1.75	1.71
Food consumed per head per day	clover hay	24.80	21.40	21.33
	barley meal	5	5.34	5.39
		Dollars.	*Dollars.*	*Dollars.*
Cost per 100 pounds gain[a]		4.85	5.16	5.31

[a] Hay at $5 per ton and barley meal at 70 cents per hundredweight.

The quality of the feed had some bearing on the economy of the feeding. The clover hay was of both first and second cutting, and had been cured in perfect condition, thus retaining all its blooms. It was intended to feed not more than one-half pound of barley meal per 100 pounds live weight per day, and this was carried out. It would seem that the best results can be obtained when the quality of the food, together with favorable climatic conditions, enable this minimum feeding. The cost per 100 pounds gain, it will be noticed, diminished as the quality of the animals increased; the range animals costing $5.16 and $5.31 per 100 pounds increase (including maintenance), as against $4.85 for lot 1, the pasture lot.

The steers were shipped to Seattle to be marketed and brought 5 cents per pound, realizing a profit of $122.59 on the bunch, which averages $3.95 per head.

ALFALFA VERSUS SORGHUM FOR WINTERING CALVES.

[E. A. BURNETT, B. S., Bulletin No. 75, Nebraska Experiment Station.]

The object of this test was to determine the relative values of alfalfa and sorghum as feed for wintering calves, but it was not a test of breeds. The number of animals was 18, and they were either three-quarters Hereford or three-quarters Shorthorn.

On December 1, 1900, after a preliminary preparation, the calves were divided into three lots of 6 head each. The daily ration of roughage for each animal was 6 pounds. Besides, a daily grain ration of 5 pounds, consisting of half corn, one-fourth oats, and one-fourth bran, was fed at first, but was gradually increased to 8 pounds per day. The test terminated on April 20, 1901, having covered a period of 141 days. The table gives the results.

Alfalfa versus sorghum for calves.

Lot.	Grain.	Alfalfa hay.	Sorghum hay.	First weight.	Last weight.	Total gain.	Average per head.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
I	6,195	7,098	....	2,515	3,930	1,415	236
II	6,195	7,098	....	2,485	3,950	1,465	244
III	6,195	....	7,098	2,425	3,735	1,310	218

Adding together the average gains of the two lots receiving alfalfa hay, we have 480 pounds, which is an average gain for those fed alfalfa of 240 pounds each. The gain of the lot fed sorghum hay, as the table shows, was 218 pounds.

PIG FEEDING IN NEVADA.

[R. H. McDOWELL, B. S., Bulletin No. 40, Nevada Experiment Station.]

Following are the details of some experiments to ascertain the value of alfalfa hay and other foods for pigs, the raising of which, it appears, has been somewhat neglected in Nevada in favor of other live stock.

Four grade Poland-China barrows were purchased for the tests and divided into two lots of 2 each. The pigs were in fair condition at the start and weighed on an average close to 140 pounds apiece. Each lot was placed in a box stall and received their feed from a hay box, which prevented unnecessary waste. They were fed three times a day and had constant access to drinking water.

Alfalfa hay fed alone 21 days (December 12 to January 2).

Lot.	Initial weight of pigs.	Hay eaten.	Weight at close.	Loss.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1	262.50	99.12	230.25	32.25
Lot 2	297.50	99.14	246.50	51.00

The pigs had been receiving a milk ration prior to the test and the abrupt change to hay was evidently undesirable. Most of the loss of weight occurred in the first week, lot 1 losing 24½ pounds and lot 2 44 pounds. "While feeding hay alone the pigs spent much time curled up in the bedding, but when about the stall were restless and, even in eating, it was done in a ravenous way, unlike that of the hearty, well-fed pig."

Alfalfa hay and white turnips (January 2 to 23).

Lot.	Initial weight of pigs.	Hay eaten.	Turnips eaten.	Weight at close.	Gain.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1	230.25	94.20	266.00	245.50	15.25
Lot 2	246.50	91.00	266.00	260.25	13.75

Much improvement took place when turnips were added to the hay, and as the feed of turnips was increased the pigs became more quiet. During the 21 days of this period lot 1 gained 15¼ pounds and lot 2 13¾ pounds. The turnips were fed without cutting.

Alfalfa hay, roots, corn, and peas (January 23 to March 6).[a]

Lot.	Initial weight of pigs.	Hay eaten.	Turnips eaten.	Corn eaten.	Peas eaten.	Weight at close.	Gain.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1	245.50	86.40	863.50	....	121.10	340.25	94.75
Lot 2	260.25	90.90	866.00	121.10	....	343.00	82.75

[a] Our turnips were exhausted on March 4; on March 7 lot 1 refused sugar beets. Lot 2 was fed on sugar beets from March 5 till March 22.

With corn and peas added to the turnips and hay the pigs made substantial gains, as the table shows. Lot 1 again came out ahead with a gain of 94¾ pounds in 6 weeks. Some peculiarities were noted in the course of feeding, it being a remarkable fact that "either lot would eat corn, but lot 2 would not eat peas. Either lot would eat white turnips, but lot 1 would not eat sugar beets." The corn and peas were fed unground, and the sugar beets were fed instead of the turnips in a short final feeding session before slaughtering.

Live and dressed weights.

Lot.	Initial weight of pigs.	Weight close hay period, 21 days.	Weight close hay and root period, 21 days.	Weight close hay, root, and grain period, 42 days.	Live weight.	Dressed weight.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1	262.50	230.25	245.50	340.25	Mar. 6, 340.25 Mar. 16, 360.00	Mar. 17, 250.25
Lot 2	297.50	246.50	260.25	343.00	Mar. 6, 343.00 Mar. 22, 405.50	Mar. 23, 289.00

Farmers who prefer not to raise root crops, unless in small quantity for a stock relish, can get direct help by adding wheat, oats, barley, peas, skimmed milk or corn. All but the latter can be readily produced in the State. Of a medium-sized dent corn we have grown nearly 52 bushels of 70 pounds each per acre.

Some good authorities say that it does not pay to cook feed. Each farmer can readily decide this for himself, according to the feed to be used, value of fuel, whether a cooking plant is owned, and the amount of freezing weather. In a cold climate pigs will eat warm feed clean from the trough when a portion of cold feed would be left to freeze. Alfalfa pasture is doubtless a help to pig raising. Alfalfa hay alone may answer to keep pigs alive till other feed can be secured, but the present experimental feeding throws doubt upon its being a progressive, growing ration. Pigs will probably do better by feeding hay liberally and allowing them to eat one-fourth to one-third and waste the remainder. Farmers will notice by the tables that as the root and grain feed was increased very little hay was eaten. Young pigs can be helped in two ways—by liberal feeding of the sow (not much grain when the pigs are quite young), and by placing slop or milk inside a rack or inclosure convenient for the pigs but out of reach of the sow.

THE VALUE OF DIPPING HOGS FOR LICE.

[A. T. PETERS, D. V. M., Bulletin No. 74, Nebraska Experiment Station.]

It has been known to the intelligent hog breeder that the presence of insects on the hog is a very serious matter. It is a fact that very few hogs are free from lice, and that breeders have been accustomed to use various remedies for the destruction of the pest. The various seats of lice on the hog are back of the ears, along the neck, and under the breast. These vermin are bloodsuckers, and they produce in a very short time a very weak, debilitated condition of the animal, making him far more susceptible to other diseases than the animal is heir to.

Owing to the comparatively large size of hog lice, their presence can often be detected before they have become very numerous, and thus measures for extermination can be taken before much mischief has been done. While the louse can not be said to be the cause of direct serious loss among pigs, it nevertheless not only prevents them from thriving, but is liable to cause considerable loss when, from any other cause, the animals are out of condition. If, for instance, the pen should be in an excessively dusty state, causing a slight pneumonia among the pigs, there would be great risk of loss if the latter were in addition badly affected with lice.

We have also found that where animals affected with cholera were free from lice there was much smaller percentage of loss sustained than where the herds were largely affected with lice. This has been brought to our attention after examining numerous herds in various parts of the State during the last five years. The first rule that we now insist upon when we visit an outbreak of cholera is to examine for lice, and, if present, to thoroughly destroy these insects. The breeding pens and hog houses are also thoroughly disinfected. All the bedding that is found in pens and hog houses at time of disinfection is burned. The method that we have for disinfecting the hogpens and hog houses is as follows: For the stables we prefer to use hot water and any of the coal-tar preparations. * * * This is done by making a 3 per cent solution of either of these preparations and using it

liberally with broom and brush and also with a spray pump. If you have any of the spray pumps used for spraying trees they will answer the purpose admirably.

After the stables and pens are thoroughly disinfected the animals should be disinfected also. This can be done by dipping them, which is a far easier method than any other. Of course, it necessitates a dipping tank. These dipping tanks can be bought on the market very reasonably. If one is not in favor of using the dipping tank, or does not feel warranted in spending the amount that it would cost to purchase one, a spray pump will do the work; but in spraying hogs one should have them on a wooden floor and must have quite a large and forcible pump, so that they can be thoroughly saturated with the liquid. If sprayed they should also be rubbed with a broom immediately, so that the fluid will soak well into the skin. The solution that we recommend is from 3 to 4 per cent for grown hogs and about 3 per cent for small pigs. In our experience we have not found any harm resulting from dipping very young pigs.

Spraying and dipping for lice can be highly recommended, as it is the only safe, rational thing to do if hogs are in any way infested with lice; and, as stated above, there is not a breeder of hogs who has not been troubled with this insect. The remedy is to dip, and dip often. It aids the very best balanced ration that can be given to a hog, by enabling him to thrive and assimilate the food administered. Breeders who have begun to dip their hogs find it very economical and a very efficient method of ridding the animals of these insects. * * *

In conclusion, I desire to say that I do not wish to convey the idea in this article that it is absolutely necessary to procure a dipping tank. I have known instances where our American farmer, with his genius for making the most of his surroundings, has soon improvised a proper dipping tank with a very little cost. It is the purpose of the writer to urge every grower of swine to dip his hogs at least every three to four weeks to have the very best success, and also to use liberally any of these dips in his hogpens; and he will attain the very best results and in a great measure prevent infectious diseases from gaining any foothold on his premises.

FINISHING WESTERN WETHERS FOR EARLY SUMMER MARKET AND FOR EARLY WINTER MARKET.

[W. J. KENNEDY, B. S. A., and F. R. MARSHALL, B. S. A., Bulletin No. 63, Iowa Experiment Station.]

FINISHING WESTERN WETHERS ON GRASS AND GRAIN FOR EARLY SUMMER MARKET.

Thousands of sheep are annually sent to the market from the Central States. The farmers of this region make a practice of procuring Western lambs and yearlings in the fall and early winter for the purpose of finishing them for market.

It has been claimed that after a feeding term of two to four months a margin of 1 cent a pound between the purchasing price and the selling price of the sheep is necessary to make the feeding profitable; but, it is averred by the writers, this has not always been the case. There have been instances, in fact, where a nice profit would have been made had the sheep been sold for the same price per pound as they were bought. There are several things which have a bearing on the economical side of the question, such as the price of feed, the age

of the animals, freight charges, etc., and there would naturally be a considerable difference between a favorable and an unfavorable combination of these. Lambs can be handled cheaper than yearlings or older sheep. It has been found also that summer feeding on grass and grass and grain is more economical than fall and winter feeding on grain and hay.

With the view of throwing some light on these matters, a bunch of 161 Idaho lambs (yearlings) were purchased on May 1, 1901. They had been on light feed during the winter months, and cost 4 cents per pound, which was increased one-fourth of a cent by the freight. The lambs were divided into six lots for the purposes of the experiments. Five of these were utilized in the summer feeding, and the other, consisting of 101, was carried over on blue-grass pasture for the winter feeding test.

The five summer lots were fed (1) on pasture alone, (2) on corn and pasture, (3) on oats and pasture, (4) on barley and pasture, and (5) on corn and oats and pasture. There was an abundance of the latter for all.

Table of summer feeding experiments.

Lot and number of sheep.	Days on feed.	Food eaten.	Average weight at beginning.	Total gain, lot.	Average daily gain.	Feed per 100 pounds gain.	Cost per 100 pounds gain.
				Pounds.	*Pounds.*		*Dollars.*
Lot 1 (15)	63	Blue-grass pasture	80.6	384	0.406		1.05
Lot 2 (15)	63	Corn, 755.5 pounds; pasture.	80.6	436	.46	Corn, 170 pounds	1.95
Lot 3 (15)	63	Oats, 748 pounds; pasture.	80.9	398	.42	Oats, 187.5 pounds	2.36
Lot 4 (15)	63	Barley, 740.5 pounds; pasture.	80.26	372	.39	Barley, 199 pounds	2.75
Lot 5 (101)	60	Oats, 1,473.5 pounds; corn, 3,933.5 pounds; pasture.	75.3	2,642	.435	Oats, 56 pounds; corn, 149 pounds.	2.26

The pasture was valued at 3 cents per week per sheep. The prices of the grain were: Oats, 23 cents per bushel; corn, 33 cents per bushel; barley, 40 cents per bushel.

It will be seen that lot 2, on corn and grass, came out best in the matter of gains, and that lot 1, on grass alone, had very much the best of it in the matter of expense. The sheep were consigned to Chicago for sale, and lots 1, 2, 3, and 5 brought 5 cents per pound, and lot 4, 4.75 cents per pound. The information obtained by the experiment indicates—

(1) That sheep will make practically as large gains on grass alone as on grain and grass.

(2) That in economy of gain grass alone gave the best results.

(3) That corn at 33 cents per bushel is a more economical grain to feed sheep on grass than oats at 23 cents or barley at 40 cents.

The feeder can oftentimes purchase half-fat lambs during the latter part of

April or the first part of May, and by grazing them for from 40 to 60 days realize a good profit, due to the advance in market prices during the latter part of June and the first of July over those ruling in April and the first part of May.

FINISHING WESTERN WETHERS FOR EARLY WINTER MARKET.

The 101 lambs which were carried over for the winter experiment furnish another example of the economy of raising mutton on grass alone during the summer. During the intervening period of 152 days these sheep made an average gain of 31 pounds per head, which, at a maintenance rate of 3 cents per head per week, is equivalent to producing mutton at 2.12 cents per pound.

The sheep were divided into seven lots on October 1, 1901, and fed thereafter for 56 days. The make-up of the lots was as below. It will be noticed that a line was taken on the value of emmer (commonly known as speltz), soy beans, and gluten feed as feeds for sheep:

Lot 1, 10 sheep fed on emmer and clover hay.

Lot 2, 10 sheep fed on soy beans and clover hay.

Lot 3, 10 sheep fed on corn 2 parts, gluten feed 1 part, and clover hay.

Lot 4, 10 sheep fed on corn and clover hay.

Lot 5, 15 sheep fed on grass, rape, and corn.

Lot 6, 30 sheep fed on grass and corn.

Lot 7, 15 sheep fed on grass alone.

The sheep in all of the lots were started on a light grain ration—about one-third of a pound per head—which was gradually increased until the emmer lot were eating 2.4 pounds per head per day, and the soy bean lot, the corn and gluten feed lot, and the corn lot were each eating 2 pounds per head per day. Bran was added to all the rations at the beginning and continued during the first fifteen days, after which it was dropped from the ration. Bran is a good regulator for the system of the animal and may well be used during the first few days in getting any class of stock to take readily to eating a new food.

Table of winter feeding experiments.

Lot and number of sheep.	Days on feed.	Feed eaten.	Average weight at beginning.	Total gain for lot.	Average daily gain.	Feed per 100 pounds gain.
			Pounds.	*Pounds.*	*Pounds.*	
Lot 1 (10)	56	Clover hay, 1,086; bran, 48; emmer, 835.	111.3	256.3	0.457	Clover hay, 423; bran, 19; emmer, 326.
Lot 2 (10)	56	Clover hay, 1,078; bran, 48; soy beans, 751.5.	110	228	.407	Clover hay, 473; bran, 21; soy beans, 229.
Lot 3 (10)	56	Clover hay, 1,078; bran, 48; corn, 507; gluten feed, 253.5.	109.8	254	.453	Clover hay, 424; bran, 19; corn, 200; gluten feed, 100.
Lot 4 (10)	56	Clover hay, 1,073; bran, 48; corn, 769.	109.5	254.7	.454	Clover hay, 421; bran, 19; corn, 302.
Lot 5 (15)	53	Grass and rape; bran, 34.5; corn, 918.	109.3	381	.453	Bran, 9; corn, 241.
Lot 6 (30)	56	Grass; bran, 73; corn, 2,062.	109.7	686.3	.409	Bran, 12; corn, 300.5.
Lot 7 (15)	56	Grass	108.6	234.3	.279	

Lot 1, on emmer and clover hay, made a slightly larger gain, both as to total and daily average, than any of the other lots, which is sufficient proof that emmer is a valuable food for sheep. Owing to the high protein content of soy beans, it would have been better if lot 2 had received part of their ration in grain, such as corn, rather than the beans alone. Had the animals been lambs, soy beans would no doubt have given better results, as they are more suitable for growing animals because of their high protein value.

Following is a valuation of the feeds used, emmer and soy beans having been estimated by using the price of corn as the unit of value. Clover hay, $8 per ton; gluten feed, $17 per ton; bran, $19 per ton; corn, 46 cents per bushel; emmer, 26½ cents per bushel of 35 pounds; soy beans, 45 cents per bushel of 60 pounds; pasture, 3 cents per week per sheep. On the basis of these valuations the cost per 100 pounds gain would be as follows:

Table showing cost per 100 pounds gain in winter experiment.

Lot and number of sheep.	Ration fed.	Cost per 100 pounds gain.
Lot 1 (10)	Emmer, clover hay (and bran to start on)	$4.35
Lot 2 (10)	Soy beans, clover hay (and bran to start on)	4.35
Lot 3 (10)	Corn, gluten feed, clover hay (and bran to start on)	4.38
Lot 4 (10)	Corn and clover hay (and bran to start on)	4.35
Lot 5 (15)	Grass, rape, and corn (and bran to start on)	3.03
Lot 6 (30)	Grass and corn (and bran to start on)	3.62
Lot 7 (15)	Grass	1.54

The results obtained show, according to the authors of this bulletin:

(1) That when corn is worth 40 [46] cents per bushel, emmer is worth 26.5 cents per bushel of 35 pounds for sheep-feeding purposes.

(2) That when corn is worth 40 [46] cents per bushel, soy beans, when they compose the sole grain ration, are worth but 45 cents per bushel for sheep-feeding purposes.

(3) That corn alone, when fed in conjunction with clover hay, produced larger and more economical gains than the ration of corn 2 parts, gluten feed 1 part, and clover hay.

(4) That sheep can be fattened more economically on grass and corn or on grass alone than on emmer and clover hay; soy beans and clover hay; corn 2 parts, gluten feed 1 part, and clover hay; or corn and clover hay.

(5) That soy beans, on account of their high protein content, should not form the sole grain ration in conjunction with clover hay for sheep-feeding purposes.

(6) That, pound for pound, corn is more valuable than emmer for sheep-feeding purposes.

LAMB FEEDING.

[F. E. EMERY, M. S., Bulletin No. 51, Wyoming Experiment Station.]

ALFALFA HAY VERSUS NATIVE HAY.

An exeriment was undertaken at the experiment station at Laramie, Wyo., in the winter of 1901–2, to ascertain the relative values of these two kinds of hay, in combination with corn, as a food for lambs. The lambs used were Merinos, and were divided into two lots, 50 in each. One lot was fed alfalfa hay and corn and the other native hay and corn. The results of the test are epitomized in the tabular statements below, showing the progress made during periods of 33, 30, and 40 days, respectively, together with a summary of the whole, and a feed table embracing the second and third periods.

The following remarks will make possible a better understanding of the figures in the table:

First period: This must be considered as preliminary to the test proper, because of a heavy snowstorm which was encountered about the middle of the period. This disorganized the trial to the extent that for 16 days the lambs could not be separated, and both lots during that time ate alfalfa hay. However, it will be seen that while the native-hay lot started the period averaging 1 pound per head heavier than the others they ended 2 pounds lighter. Thus the alfalfa-fed lambs at once took the lead; they had stronger appetites, and therefore were enabled to eat more hay than the others. "Besides the greater weight of hay consumed, these lambs were receiving a better balanced ration, and doubtless more digestible nutrients in an equal weight of hay than was lot 1 in the native hay." The corn ration during the period did not exceed one-half pound per head per day.

Second period: Soon after the commencement of this period the corn was increased to the full feed of 1 pound per head per day. Lot 2 continued on the increase, doing a little better than in the first period, but the native hay lot deteriorated, their aggregate gain for the period being less than half that of lot 2.

Third period: A smaller quantity of hay was eaten in this period by both lots, and "corn was also reduced to lot 1. It would doubtless have been well, in view of the high price, to have held back the corn and used more hay, but this was not done, and the feeding was carried along as planned." More hay was consumed toward the end of the period, but not as much as originally. Lot 2 gained 13.2 pounds per head in the 40 days comprising this period, as against 9.8 pounds per head for lot 1. The latter, however, it will be seen, made a great improvement over the preceding period.

Summary.—The summary table shows that lot 2, fed on alfalfa hay and corn, were in distinctly better condition at the end of the test than lot 1, fed on native hay and corn. The average gain per head of the latter for the whole period of 103 days was 18.1 pounds,

whereas the alfalfa lot gained 28.6 per head—a difference in their favor of 10½ pounds per head.

Cost of food, etc.—The feed table gives a line on the comparative cost of the two rations, which may be arrived at by taking the expense items in conjunction with the gains of the second and third periods, these being the only periods covered by the feed table. The aggregate gains of lot 1 for the periods named were 13.1 pounds per head, and the cost $1.26 per head, while lot 2 gained 20.7 pounds, at an expense of $1.55 per head. This is equivalent to a cost of $9.62 per 100 pounds gain for the native-hay lot and $7.49 per 100 pounds gain for the alfalfa-hay lot. The latter, therefore, was the more economical of the two by more than 2 cents per pound.

	Lot 1. Fed on native hay and corn.	Lot 2. Fed on alfalfa hay and corn.
First period.	*Pounds.*	*Pounds.*
Total weight of lot, December 2, 1901	2,300	2,267
Average weight per head, December 2, 1901	46.2	45.3
Total weight of lot, January 4, 1902	2,560	2,660
Average weight per head, January 4, 1902	51.2	53.2
Total gain in 33 days	250	393
Average gain per head in 33 days	5	7.9
Second period.		
Total weight of lot, February 3, 1902	2,725	3,035
Average weight per head, February 3, 1902	54.5	60.7
Total gain in 30 days	165	375
Average gain per head in 30 days	3.3	7.5
Third period.		
Total weight of lot, March 15, 1902	3,215	3,695
Average weight per head, March 15, 1902	64.3	73.9
Total gain in 40 days	490	660
Average gain per head in 40 days	9.8	13.2
Summary.		
Total weight of lot, December 2, 1901	2,310	2,267
Average weight per head, December 2, 1901	46.2	45.3
Total weight of lot, March 15, 1902	3,215	3,695
Average weight per head, March 15, 1902	64.3	73.9
Total gain in 103 days	905	1,428
Average gain per head in 103 days	18.1	28.6
Feed for second and third periods. [a]	*Dollars.*	*Dollars.*
Cost of 3,365 pounds native hay, at $11 per ton	18.51	----------
Cost of 2,953 pounds corn, at $30 per ton	44.29	----------
Cost of 4,965 pounds alfalfa hay, at $12 per ton	----------	29.85
Cost of 3,175 pounds corn, at $30 per ton	----------	47.63
Total cost of feed for 70 days	62.80	77.48
Average cost per head of feed for 70 days	1.26	1.55
Cost per 100 pounds gain	9 62	7.49

[a] Feed for first period can not be computed owing to interruption by storm. (See remarks under first period.)

BREEDING EXPERIMENTS WITH SHEEP.

[FREDERICK B. MUMFORD, M. S., Bulletin No. 53, Missouri Experiment Station.]

SOME FACTORS INFLUENCING THE WEIGHT OF LAMBS AT BIRTH.

Experiments with the object of investigating the factors influencing the weight of lambs at birth were conducted at Columbia, Mo., during a period of four years—from 1898 to 1901. The rams used were pure-bred registered animals of the Hampshire, Shropshire, and Delaine Merino breeds. The ewes were natives of mixed breeding. They were somewhat common in character, and their general condition during the experiment was "rather below than above desirable breeding form." Each ram served a flock of 10 or 12 ewes annually.

A heavy weight at birth is generally considered to be desirable, because of the connection it often has with the future growth and development.

The average birth weight of all breeds and sexes during the experiment was 7.7 pounds. Stillborn lambs were much below the average in weight.

RELATION OF BREED AND WEIGHT OF RAM TO BIRTH WEIGHT OF LAMBS.

A comparison of the respective weights of the rams and lambs in the table below will show that the breed and weight of the ram has apparently no bearing upon the weight of the offspring.

Breed and year.	Number of lambs.	Weight of ram.	Birth weight of lambs.	Average for breed.
Hampshire:		*Pounds.*	*Pounds.*	*Pounds.*
1898	11	145	8.54	7.83
1899	8	145	7.91	
1900	10	225	7.41	
1901	12	225	7.48	
Shropshire:				
1898	7	250	9.78	8.41
1899	10	250	8.00	
1900	8	140	7.94	
1901	8	140	7.93	
Merino:				
1898	6	140	8.75	7.70
1899	9	140	7.99	
1900	10	145	7.59	
1901	11	145	7.55	

RELATION OF WEIGHT OF MOTHER TO BIRTH WEIGHT OF LAMBS.

It would seem that the size of the mother and her nutritive condition must have an important relation to the size and weight of the young at birth. It is highly important that the mother should possess a controlling influence in determining the birth weight, otherwise disastrous results might universally follow the mating of small females and large males. If the male has a controlling, or even an equal, share in the determination of the birth weight, then it must follow that the mating of small females with large males is attended with some risk.

The ewes were weighed in December, 1899. While it is possible for the nutritive condition of the ewes to have some influence on the weight of the lambs at birth, this matter had to be eliminated in the present case because no data on that point were obtained. It is a question whether any information complete enough to be of use could be had under any circumstances. But the relation of the size or weight of the ewes to the birth weight of the lambs, as shown by the following table, seems to establish the following facts:

(1) The heavier the ewe the greater the birth weight of the lamb.

(2) The birth weight seems to increase with considerable uniformity, and in direct relation to the increased size of the dam.

Weight of dams.	Single lambs.	Average birth weight of single lambs.	Twin lambs.	Average birth weight of twin lambs.	Average birth weight of all lambs.
	Number.	*Pounds.*	*Number.*	*Pounds.*	*Pounds.*
Below 90 pounds	8	7.2	0	0	7.2
£0 to 100 pounds	6	7.4	0	0	7.4
100 to 110 pounds	14	8.6	8	6.4	7.5
110 to 120 pounds	12	8.7	20	7.2	7.9
120 to 130 pounds	13	8.9	10	7.6	8.3

INFLUENCE OF SEX OF LAMBS UPON BIRTH WEIGHT.

Male lambs proved to be 1.12 pounds, or 16 per cent, heavier at birth than females, but as a result of figures compiled during the last two years of the experiment, in respect of the average weekly gain for the first seven weeks, it appears there was no conclusive evidence that male lambs did any better (because of sex) after birth than females.

TWIN LAMBS VERSUS SINGLE LAMBS.

The table below shows that there is very little difference between the weight of single lambs and of twins at birth. Single females weighed about three-fourths of a pound more than twin females, and the difference between the single and twin males was even less, while the twin males were actually slightly in excess of the single females.

The smaller size of twin lambs observed in most flocks is undoubtedly more the result of insufficient nutrition while suckling than it is the inferior size at birth. Very few ewes yield sufficient milk to properly nourish two thrifty, early maturing lambs. If such lambs are early taught to eat grain and hay, the twin lambs will in most cases thrive equally as well as the single lambs of the same birth weight. With a little attention lambs may be taught to eat at a very early age, and grain fed at this time, while the lamb is suckling, will produce larger gains than at any later time. If the twin lambs begin early to supplement the milk of the mother by eating corn, oats, clover hay and possibly a little oil meal, they will thrive and in the end become as thrifty as single lambs. A flock of ewes that has been bred for the production of twins may thus become considerably more profitable than a flock producing single lambs only. On the other hand, if the breeder fails to supply the extra feed and care necessary for the twin lambs, it may be, as often stated, that one good single lamb is better than two puny twins.

Birth weight of single and twin lambs.

Description of lambs.	Cases observed.	Average birth weight.
	Number.	*Pounds.*
All lambs	117	7.70
Single lambs (both sexes)	57	7.80
Single male lambs	33	8.11
Single female lambs	24	7.34
Twin lambs (both sexes)	38	7.07
Twin male lambs	17	7.45
Twin female lambs	21	6.53

RELATION OF BIRTH WEIGHT TO LATER GROWTH.

The results obtained in this portion of the experiment point to the great advantage possessed by the heavy lambs, and consequently to the great profit which may be acquired by paying strict attention to the lamb before it is born. To this end it is recommended that the nutrition of the ewes before and during pregnancy be carefully supervised. A generous supply of corn alone, for instance, would probably be bad for the unborn lamb. The corn should be supplemented with a number of other foods which would supply the nutrients deficient in it, such as alfalfa, clover, and cowpea hay, linseed meal, bran, etc.

A table of gains after birth by various sizes of lambs is here given:

Birth weight of lambs.	Lambs.	Average length of feeding period.	Average weekly gain, including birth weight.	Average weekly gain, excluding birth weight.
	Number.	*Weeks.*	*Pounds.*	*Pounds.*
10 pounds and above	7	8.55	5.40	4.50
9 to 10 pounds	8	6.05	5.50	4.20
8 to 9 pounds	14	7.33	3.70	2.50
7 to 8 pounds	13	9.03	3.40	2.30
Below 7 pounds	6	7.05	2.62	1.70

Some information was also gathered regarding the influence of inbreeding on the birth weight of lambs. The results obtained showed the half-bloods to be much superior to the three-quarter bloods in this respect, but the methods employed were admitted not to be sufficiently searching to warrant very absolute conclusions.

SUMMARY OF RESULTS.

The birth weight of lambs is largely or entirely controlled by the mothers.

Neither the breed nor the size of the rams used were determining factors in fixing the birth weight of lambs.

Male lambs were 16 per cent heavier at birth than female lambs.

The male lambs made a slightly better gain for an average period of seven weeks after birth (the extent of our observations) than did the female lambs.

The average birth weight of twin lambs was only one-half pound below the general average.

The heavy lambs at birth made much greater gains in the seven succeeding weeks than the light ones.

QUANTITY AND ANALYSIS OF EWE'S MILK.

[FREDERICK B. MUMFORD, M. S., Bulletin No. 53, Missouri Experiment Station.]

It became necessary to milk a few ewes in connection with an experiment in the spring of 1902, and so advantage was taken of the opportunity to make independent tests bearing upon the following: The amount of milk given by ewes; the amount of milk and fat produced by a given quantity of feed, and, incidentally, the gains made by lambs fed, respectively, on ewe's milk, cow's milk, and by suckling, the whole being rounded out by a chemical analysis of ewe's milk.

MILK YIELD OF EWES.

This experiment extended over fifteen weeks. Five ewes selected from the flock which was used in the breeding experiments (of which an account is given elsewhere) were utilized as subjects. These ewes were natives, of mixed breeding, with Shropshire and Cotswold strains predominating. They were the heaviest milkers in the flock, and were at first milked four times a day, but later three times, and toward the close only twice a day. They were fed on alfalfa and clover hay and corn.

Average weekly yield.

Week ending—	Ewe No. 30.	Ewe No. 32.	Ewe No. 33.	Ewe No. 34.	Ewe No. 35.
1902.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
February 23	19.09	----------	14.87	28.12	----------
March 2	20.81	16.34	15.09	28.18	5.71
March 9	16.75	22.21	14.59	26.84	21.03
March 16	14.43	17.90	11.68	22.78	15.46
March 23	16.81	18.46	15.31	22.28	16.46
March 30	16.34	16.09	11.18	19.34	14.65
April 6	13.50	12.03	10.65	16.28	12.71
April 13	13.00	10.12	10.96	16.78	14.90
April 20	12.01	10.60	11.10	14.00	14.20
April 27	15.20	13.40	14.20	17.00	14.50
May 4	13.50	13.90	14.9	15.2	13.3
May 11	13.7	12.6	14.9	14.8	13.2
May 18	16.9	16.3	15.4	16.2	13.6
May 25	15.0	16.7	13.6	13.0	12.3
June 1	15.4	16.5	15.0	14.2	12.8
Total	232.44	213.15	203.43	285.00	194.82
Average weekly	15.50	15.22	13.56	19.0	13.92
Average daily	2.21	2.17	1.94	2.71	1.99

Owing to the fact that sheep have not been used for milk in this country the period of lactation is only of sufficient duration to properly nourish the lamb; but the results of this test indicate that it would not be difficult to prolong the period of lactation to a considerable extent. The average yield of the fifteenth week was even greater in the case of Nos. 32 and 33 than the average for the whole fifteen weeks of the test, and in Nos. 30 and 35 but slightly less. No. 34, however, which gave much the greater quantity of milk, showed a greater and more rapid diminution than any of the others. This ewe, in which the blood of the Cotswold predominated, gave her large yield of milk during the earlier weeks of her lactation, and her ratio of diminution would suggest that she would have "gone dry" before any of the others.

FEED RECORD OF MILCH EWES.

The amount of feed from which certain quantities of milk were produced is the subject of the next table. Three of the ewes were separated from the rest and careful account taken of the amount of food consumed. The test covered only one week—that ending March 23, 1902—and a reference to the previous table will show that the yields for this particular week, while not in any instance the highest, were nevertheless considerably higher than the average for the fifteen weeks.

Seven days' record of feed and milk yield.

Ewe—	Corn.	Clover hay.	Milk yield.	Butter fat.	Weight of ewe.
	Pounds.	*Pounds.*	*Pounds.*	*Per cent.*	*Pounds.*
No. 32	12.3	14.5	18.4	7.1	90
No. 34	12.0	18.5	22.3	6.9	115
No. 35	12.3	14.5	16.4	7.8	110

Feed required for production of milk and butter fat.

Ewe—	Grain for 1 pound milk.	Roughage for 1 pound milk.	Grain for 1 pound fat.	Roughage for 1 pound fat.	Dry matter for 1 pound milk.	Dry matter for 1 pound fat.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
No. 32	0.68	0.79	9.6	11.2	1.3	18.0
No. 34	.54	.82	7.8	12.0	1.2	17.1
No. 35	.77	.90	9.8	11.5	1.4	18.6

GAIN OF LAMBS ON EWE'S AND COW'S MILK.

A table is presented showing the gains made by lambs under three different conditions of milk feeding, namely, by cow's milk from bottle, by ewe's milk from bottle, and by the natural method of suckling.

It will be observed that the highest gains were made by the lambs receiving ewe's milk from a bottle. The greater gain of this lot over the lot allowed to

suckle their dams is accounted for by the fact that the 4 lambs fed with a bottle received the entire milk from 8 ewes. The gains made on cow's milk were not large, but were still satisfactory, and indicate that lambs may be successfully reared on cow's milk alone.

The lambs receiving ewe's milk developed a more abundant yolk and this was of a uniform yellow color. The yolk in the fleeces of the lambs receiving cow's milk was not evenly distributed and was very light colored. This difference in the quality and quantity of the yolk was very noticeable, and the greater oiliness of the fleeces of the lambs fed ewe's milk increased proportionally much faster than on the lambs fed cow's milk.

Record of growth of lambs.

Feed of lambs.	Number of lambs.	Length of period.	Total gain.	Average weekly gain.	Average weight at end.
		Days.	*Pounds.*	*Pounds.*	*Pounds.*
Cow's milk from bottle	4	77	118	2.95	44.3
Do	7	77	247	3.22	42.7
Ewe's milk from bottle	4	77	181	4.11	58.1
Suckling ewes	4	77	163	3.70	45.1

ANALYSIS OF EWE'S MILK.

An analysis of ewe's milk is also presented, as below. The average of all the tests given in the table makes the composition of ewe's milk as follows: Total solids, 17.85 per cent, made up of protein, 5.071; fat, 6.783; ash, 0.864; and sugar (by difference), 5.132.

The Babcock test was used in determing the fat.

Analyses of ewe's milk, made by Dr. Schweitzer.

	May 14, No. 34.	May 26.			June 3, No. 34.	
		No. 32.	No. 34.	No. 35.	Morning.	Evening.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Total solids	19.968					
	20.016			17.78	16.07	17.22
	19.952	16.79	17.47	18.30	15.88	17.08
	19.968	17.38	18.23	18.29	15.94	17.12
Average	19.98	17.08	17.85	18.12	15.96	17.14
Protein	5.096				5.022	5.044
	5.129	5.7			4.986	4.937
Average	5.11	5.22	5.31	4.79	5.00	4.99
Fat	9.248					
	9.304					
Average	9.27	6.01	6.64	7.48	5.197	6.096
Ash	.890					
	.899					
Average	.89	.87	.93	.81	.822	.855
Sugar (by difference)	4.688	4.98	4.77	5.04	4.922	5.145

POULTRY EXPERIMENTS.

[O. M. WATSON, Bulletin No. 74, South Carolina Experiment Station.]

TURKEYS.

Considerable loss of eggs occurs when turkeys are allowed to wander at will during the laying season. Some nests are not found and others are destroyed or damaged from various causes. In view, therefore, of the saving of eggs which could be secured by confining the turkeys, it was determined to find out what effect this would have upon the fertility of the eggs.

Two Bronze hens and two White Holland hens were used, all of them 2 years old. The Bronze tom was 1 year old and the White Holland 3 years old. Each lot was confined in a run 80 by 100 feet. Two nests, 36 inches square, were made in each run. These were covered to keep out the rain, and some brush was placed in front of each for privacy.

A variety of feed was given—in the morning a mash of equal parts of wheat, bran, and corn meal, and at night whole corn and wheat alternately. Ground bone and meat was given twice a week, and a supply of oyster shells was always on hand.

The eggs produced and the periods of laying were as follows:

Breed.	Commenced laying.	Stopped laying.	Number of eggs produced.
Bronze	Mar. 26	Apr. 22	42
White Holland	Mar. 24	May 4	36

The fertility of the eggs is shown in the following table:

Breed.	Number of eggs set.	Number of fertile eggs, tenth day.	Number of turkeys hatched.
Bronze	42	38	27
White Holland	36	27	16

There were 10 fertile eggs broken during incubation, 4 by the Bronze hens and 6 by the White Holland. The eggs that failed to hatch were laid during the first two weeks.

CHICKENS.

Below are particulars of two experiments with some of the best known breeds of chickens, together with several crosses, to ascertain their commercial value when raised for broilers. Three of the most available and least expensive kinds of thoroughbreds, with four kinds of

crosses, were put in for comparison. The fowls used were 2 years old. After 10 eggs from each of these fowls had been hatched in an incubator the chickens were put into a sectional hot-water brooder. They were fed in the following manner:

MANNER OF FEEDING.

They were fed the first week on bread, made of equal parts of corn meal and wheat bran, mixed with salt, buttermilk, and soda, and thoroughly baked. They were fed five time each day and allowed to eat all they wanted each time. As soon as they had all eaten as much as they wanted, the feed trough was taken out and cleaned. The second week they were fed bread at 6 o'clock, beef scraps at 10, bread at 2, and at 4 German millet was scattered in straw for them to work on until night. From the third week through the experiment they were fed bread, beef scrap, cracked corn, and cracked wheat. They also had skimmed milk or buttermilk once each day. In addition to this they were fed green food each day, all they would eat. The green food consisted of rye, lettuce, rape, and kale.

The results of the feeding at the end of 2 weeks, 4 weeks, 8 weeks, and 12 weeks, respectively, are given in the tables below:

Experiment No. 1 in feeding chickens.

Breed.	Weight per chicken.			
	Second week.	Fourth week.	Eighth week.	Twelfth week.
	Ounces.	*Ounces.*	*Ounces.*	*Ounces.*
Barred Plymouth Rock	3½	9	28	43
Silver-Laced Wyandotte	3	8¼	27	41
Indian Game	2¾	8	27½	42
Indian Game crossed on Barred Plymouth Rock	4	10	32½	46
Pit Game crossed on Barred Plymouth Rock	3¾	9½	31¼	45
Barred Plymouth Rock crossed on common hens	2½	7¾	26½	42
Silver-Laced Wyandotte crossed on common hens	2¾	8	25¼	40

Experiment No. 2 in feeding chickens.

Breed.	Weight per chicken.			
	Second week.	Fourth week.	Eighth week.	Twelfth week.
	Ounces.	*Ounces.*	*Ounces.*	*Ounces.*
Barred Plymouth Rock	3¾	9½	29	43½
Silver-Laced Wyandotte	3	8¾	28¼	42½
Indian Game	3	9	28¾	43
Indian Game crossed on Barred Plymouth Rock	4	10¼	32	45½
Pit Game crossed on Barred Plymouth Rock	3½	10	31¾	46
Barred Plymouth Rock crossed on common hens	3¼	8½	28	43
Silver-Laced Wyandotte crossed on common hens	3	8¾	26½	41

The Wyandotte, Indian Game, and Plymouth Rock cross and Pit Game and Plymouth Rock cross showed a plump breast. The Pit Game and Plymouth Rock cross, the Plymouth Rock and common cross, and the Wyandotte had most feathers. The Indian Game had very few feathers, but was plump.

The cost of feed per chicken to eight weeks was 7½ cents. The cost of feed per chicken to twelve weeks was 12 cents. The cost for feed when this experiment was made was unusually high. No account of green food given was kept.

COMMON DISEASES AND REMEDIES.

Cleanliness is the chief preventive of disease. Lime should be used freely.

To prevent cholera in summer use 10 drops of sulphuric acid in 1 gallon of water twice a week.

To avoid bowel complaint in chickens 1 to 2 weeks old use scalded milk instead of the drinking water.

To get rid of lice in young chickens grease their heads with a mixture of equal parts of kerosene and lard. If put on when the chickens are hatched it will keep off the lice.

For sore head, good results were obtained by greasing the whole head with a mixture of chloronaphtholeum 1 part and lard 4 parts.

Painting the inside of nests with crude carbolic acid has been found an unfailing remedy for keeping away mites from sitting hens.

MISCELLANEOUS INFORMATION.

Death of cattle supposed to be due to Strongylus micrurus.—The following is a report upon a disease of cattle upon the farm of Mr. F. C. Mugler, of Caddo, Ind. T., which was made by Dr. Louis A. Klein, an inspector of this Bureau:

Last winter and spring (1902) Mr. Mugler bought about 700 short yearlings from farmers in Grayson and Collin counties, Tex. The first purchases were shipped to Caney and Caddo, Ind. T., where they were wintered with 2-year-old and 3-year-old steers, natives of the Indian Territory. The last purchases, about 300 head, were shipped direct to Stringtown, Ind. T., and put in a pasture at that point, arriving there on March 16. On March 29 the cattle which had been held near Caney were also put in this pasture. There were 389 head in this lot, about 100 being yearlings bought in Texas and the others 2-year-old and 3-year-old Territory steers.

About this time the cattle in the pasture near Caddo began to die. These cattle were moved to the Stringtown pasture on April 18. Up to that time 8 head had died, 8 or 10 more were too weak to move and have since died, and 4 or 5 were left along the road. The morning after they were put in the Stringtown pasture 2 were found dead. There were 418 head in this lot, 311 of them being yearlings from Texas, and the others 2-year-old and 3-year-old Territory steers. All those that had died or had showed symptoms of the disease were Texas yearlings. They continued to die at the rate of 2 or 3 a week. The other cattle in the pasture were not affected for six or seven weeks. Then the yearlings among them began to show symptoms of the disease, and from that time to the date of my visit they had continued to die, the rate of mortality varying with the weather.

On July 11, 53 head, and on August 15, 70 head, of 2-year-old and 3-year-old Territory steers were put in this pasture, making in all 1,200 head.

The pasture embraces 6 sections of land, about 60 per cent of it being prairie and the balance timber, and it is well watered by running streams. The grass was burned off by a timber fire last February, but there was a good growth of grass when the cattle were put into the pasture. The excessive rains of the summer made the grass grow luxuriantly, but the young cattle did not thrive. On September 20, 60 head of the thinnest yearlings were cut out and fed cotton seed in addition to the grass. The young cattle continuing unthrifty and the deaths persisting, those in the poorest condition, about 400 head, were put in the feed lots on November 7, so that they could be better cared for, and they were put on a ration of hay and cotton-seed meal cake. The other cattle were turned loose on the mountains. The young cattle continued to die, and up to January 15, 1903, 250 head were dead. The cattle on the mountains have been closely observed, and so far as is known no deaths have occurred among them. They are mostly 2-year-old, 3-year-old, and 4-year-old steers.

In all cases the symptoms exhibited were the same. Coughing and depression are the first indications of the disease. The affected animal lags behind the herd and walks as if weak and languid, the ears hang listlessly, the eyes are dull, there is a short, shallow cough, and a white purulent nasal discharge. The appetite is

voracious, but the animal gradually becomes emaciated, becoming weaker and weaker until finally it can not rise. The cough increases in frequency, respiration is more rapid and difficult, the pulse is weak, subcutaneous edemas appear in the dependent parts, anemia develops, and finally the animal dies from exhaustion. Death occurs in from seven to eight days to two or three weeks, depending on the weather. The disease is usually fatal.

One of the affected animals had been found dead just before my arrival at the ranch and I held an autopsy on the carcass. The organs and tissues were all anemic and there was great emaciation. The lungs showed several large areas of broncho-pneumonia. When section was made of these areas and the tissues squeezed, numerous white thread-like worms were pressed out of the bronchial tubes. These worms, which appear to be the *Strongylus micrurus*, are without doubt the cause of the deaths among these cattle. Circumstances seem to indicate that the parasites were introduced into the Stringtown pasture through the yearlings that had been wintered near Caddo. The conditions in the Stringtown pasture were ideal for the propagation for the parasites. The first bedground of the cattle and the place where many of them died was on the side of a hill, at the bottom of which was a water hole, which was their favorite drinking place. The summer and fall were very wet, favoring the growth of the parasites, and during the winter there had been many cold, damp, or rainy days, reducing the vitality of the cattle.

I advised Mr. Mugler's manager to feed the young cattle as strong as possible, and to give them iron and gentian in their salt, and also to remove animals that coughed to a separate lot as soon as they were discovered. I further advised him to burn off the pastures next spring and to keep any young animals that he may buy separate from his present herd and on the higher parts of the pasture.

As I was leaving Stringtown I was informed by Mr. P. I. Sparks that he had purchased 675 head of stock cattle in Lampasas and Mills counties, Tex., last spring and put them in a pasture north of Stringtown. About November 1 the cattle began to die, showing the same symptoms as Mr. Mugler's cattle showed, and up to January 15, 1903, he had lost 47 head, all yearlings. He held a post-mortem on the last one that died and found worms in the lungs. Mr. Sparks also stated that a firm, who had 300 cattle on a ranch near his place, which they had bought last spring in Mills County, Tex., had lost 25 yearlings with the same disease.

So far as I could learn this disease has not previously been observed in the vicinity of Stringtown.

Demand for American horses in France.—American horses are in demand in France. The French army purchases annually a large number of these animals, and on the farms they are gradually displacing cattle for draft purposes. For many years the soil has been cultivated almost entirely with the aid of cows and oxen, but for this work the superiority of the horse is fully acknowledged. The introduction into France of American agricultural machinery, such as mowers, reapers, drills, rakes, etc., has also led to the use of horses in greater number than ever before. The exodus of laborers from the farms to the cities is still another explanation of the increased demand for draft animals. This exodus is also responsible for the increasing use of farm machinery. The scythe is giving place to the mower, the old-fashioned method of sowing to the modern drill, and these machines are worked best by horses. A leading agriculturist stated

recently that "the demand for agricultural machinery to replace hand labor on the French farms will be greater this year than ever before."

The importation of horses from Argentina and Russia has not been entirely successful. The mortality en route, the high freight rates, and the great change in climate (with regard to horses shipped from South America) make the selling prices in France almost prohibitive.

Colts 3 to 4 years old have been successfully imported from the United States. When shipped at this age the animals are less liable to injury and less susceptible to climatic changes. Care should be taken to send only sound specimens. Upon arrival at French ports the animals are carefully examined by veterinarians, who exclude all in any way defective. Closer attention should also be paid to the shipping of the horses, many of which arrive in a deplorable condition. Arrangements should be made for properly caring for the animals after they reach their destination. This could readily be done, and the expense incurred would more than be made up by the increased prices that would be obtained.—(*Walter T. Griffin, Commercial Agent, Limoges, in Consular Report, June 23, 1902.*)

Horse breeding in Germany and France.—It is only during the last few years that special attention has been given to horse breeding in Germany. Careful inquiries into the subject show that the system so far followed does not fill the requirements of the army or of the public in general. While in England, France, Belgium, and Denmark horse breeding pays farmers, especially small ones, better than any other branch of industry, this is not true in Germany, where many complaints are heard with regard to Government rules, which are said to be adverse to a favorable development of horse breeding. In consequence, the importation of foreign-bred animals is continually increasing. In 1900 France exported 3,000 horses more than she imported, but Germany had to import 90,000 more than she exported. In view of these facts, the German foreign office sent an expert to northern France to investigate French horse breeding. His printed report says, in part:

After the Franco-German war (1870-71), French horse breeding was nearly ruined, and in 1874 the French Chamber of Deputies had to grant money to gradually reestablish it, and the success now attained proves the wisdom of that act. In France, 18,000,000 francs ($3,474,000)—of which the State alone contributes 2,355,570 francs ($454,625)—are spent every year in the improvement of horse breeding, while in Germany the Government spends only a little more than 300,000 marks ($71,400) and gives a number of prizes for races.

Among the causes which have contributed to the advancement of horse breeding in France is the fact that the whole management is under the charge of a specially appointed staff; in Germany it rests in the hands of one man. At the head of the French staff (under the supervision of the minister of agriculture) is the director-general, with his seat in Paris. Under him are inspectors-general and other necessary employees, who purchase and care for the stallions for the State.

Another beneficial institution is the stud school at Le Pin, where the training of

employees is finished. The "breaking-in schools" (écoles de dressage) are of great help in the rearing of half-bred horses. The better classes of coachmen and horse grooms often come from these schools. The skillful way in which the Paris hackney coachmen handle their horses and make their way through the crowded thoroughfares—due less to use of the whip than to attention—should be credited to a great extent to the beneficial influences exercised by the "écoles de dressage."

The forming of horse-breeders' unions, a rational selection of stud-horses, and some method of helping private persons or associations to keep the necessary stud animals is advised. France had, in 1900, 3,087 stallions belonging to the State and 7,480 to private persons, while in the Kingdom of Prussia only 2,924 stallions belonged to the State and 1,599 to private parties; and it must be remembered that Prussia is doing more than any other German State to improve her horse-breeding establishments.—(*Oliver J. D. Hughes, Consul-General at Coburg, in Consular Report, October, 1902.*)

Importation of cattle into Cuba.—The Department [of State] has received from Minister Squiers, of Habana, under date of October 31, 1902, translation of the regulations governing the importation of cattle into Cuba. These regulations relate to the execution of the law of September 15, 1902, regarding the collection of tariff duties on cattle, horses, and sheep imported into the island, and are summarized as follows:

The importation of cattle shall be effected through the ports authorized for the import trade; the sanitary inspection provided for in article 121 of the customs regulations shall continue to be made. Calves under 2 years, separated from the mother, shall be considered yearlings; imported with the mothers, under 1 year, shall be considered unweaned (crías). Cattle under 2 years, separated or weaned from their mothers, shall be considered calves. The class of breeding bulls shall be proven by the certificate of origin, viséed by the Cuban consul or the person discharging the duties of such. In order to facilitate the discharge of cattle, customs administrators are authorized after each cargo of cattle has been examined by the veterinary inspector to classify it according to the declaration of the importer as thin or fat, sending each class to a separate pen. In case of doubt they shall be weighed together, and if the customs officer and the importer differ as to the result of the average each lot shall be weighed, head by head, and the animals classified according to the resulting weight. Thin cattle shall be marked with an iron indicating the day, month, and year of importation. Tickets shall be delivered to the importers so that they may enter separately the fat and thin cattle imported. The date of importation, as to the thin ones, must be entered in the cattle registry according to the brand with which they may have been marked in the custom-house. The classes, conditions, and origin of the imported cattle shall also be entered in such registers. The slaughter of thin imported cattle shall not be permitted before the expiration of three months. Before being slaughtered each head of cattle shall be inspected, a fine of $20 being imposed should the brand show that it has not been imported three months. The slaughter of female cattle shall not be permitted, except such as are over 10 years of age, having been pronounced useless for breeding purposes by either a veterinary or a practical cattle raiser.

Altered horses and mules shall pay according to their height, that condition and their height being made to appear in the custom-house documents.

The exportation of cattle is absolutely forbidden. The shipping of cattle for the consumption of crews and passengers of vessels is authorized only in proportion to the number of same and the duration of the voyage, according to the itinerary. Cows or date-marked cattle before the expiration of three months can not be used. In conformity with the provisions of the law of September 15, the nomenclature of the customs tariff in force is modified in the following manner as to the animals included in group 1 of class 1:

ITEM 181.—*Horses and mares.*

(*a*) Stallions for breeding, upward of 150 centimeters (59 inches) in height, measured by square (perpendicularly)	Free.
(*b*) Those not exceeding that measure	$5.00
(*c*) Altered horses over 150 centimeters (59 inches)	15.00
(*d*) Altered horses less than that height	2.00
(*e*) Mares fit for breeding	3.00
(*f*) Mares unfit for breeding	15.00

ITEM 182.—*Mules.*

(*a*) Mules exceeding the established height	$10.00
(*b*) Mules under the established height	5.00

ITEM 183.—*Asses.*

(*a*) Breeding asses, males over 130 centimeters (51 inches) in height, measured by square (perpendicularly)	Free.
(*b*) Other asses, male and female	$5.00

ITEM 184.—*Horned cattle.*

(*a*) Cows, fit for breeding, and heifers	Free.
(*b*) Cows with the calf	Free.
(*c*) Breeding bulls of the following breeds: Jersey, Guernsey, Devonshire, Durham, Herefords from Porto Rico and the Argentine Republic; provided that the importer duly proves their origin	Free.
(*d*) Yearling bulls	$1.00
(*e*) Male cattle from Florida, over 500 pounds each	5.00
(*f*) Male cattle from Honduras, over 600 pounds each	5.00
(*g*) Fat male cattle from Mexico, exceeding 700 pounds each	7.00
(*h*) Fat cattle from Venezuela and Colombia, or from countries other than those mentioned, over 800 pounds each	8.00
(*i*) Thin cattle—that is, such as do not reach the weights mentioned—according to their origin	2.00

ITEM 106.—*Sheep and goats.*

(*a*) Sheep, females	Free.
(*b*) He goats and rams, each	$1.00

—(*Consular Report, February, 1903.*)

Meat and cattle trade in Barcelona.—The increased price of foodstuffs in Spain has for some time given rise to repeated complaints, and has contributed in no small degree to the prevailing discontent among the laboring classes in the large manufacturing centers.

The proposal recently made in the Cortes to either waive entirely the import duty on cattle or to reduce it considerably is not likely to be carried, owing to the strong opposition any such measure would meet from the wealthy landowners and other influential persons whose interests would thus be sacrificed.

Efforts are being made to induce the Government to make Barcelona the port of arrival for live cattle; and the town authorities, appreciating the desirability of cheapening the price of meat, have offered to provide the means of properly inspecting and disinfecting the cattle on arrival. If at the same time it could be arranged for refrigerator steamers to call here on their way to Marseilles and Genoa, there seems to be no reason why a large business should not be done in meat from the United States; or this might be effected by arranging a connection with the steamers at either of those ports.

The imports (46,969,964 pounds in weight) into Barcelona during 1901 were:

Description.	Head.	Description.	Head.
Oxen	12,538	Lambs	107,339
Cows	14,318	Ewes	87,003
Calves	39,777	Pigs	60,000
Sheep	349,248	Total	708,247
Goats	16,668		
Kids	21,356		

The duty per head on cattle is as follows:

Description.	Duty.	
	Pesetas.	
Oxen	40.00	[a] $5.44
Cows	35.00	4.76
Calves	25.00	3.40
Sheep	2.40	.326
Goats	2.40	.326

[a] Taking the current market value of the peseta as 13.6 cents.

Imports by land from Portugal are entered duty free. The "octroi," or municipal tax, on meat is 0.30 peseta (4.08 cents) per kilogram (2.2 pounds).

The trade is in the hands of a few dealers called "abastecedores," who import the cattle and attend to the slaughter, which is done for their account at the public slaughterhouses. Each of these abastecedores supplies a certain number of butchers with the meat to be sold either in the markets or in private shops, obliging them to pay cash on delivery.

Before the meat leaves the slaughterhouses it is examined by the

sanitary inspectors, and none is supposed to pass that is not perfectly fresh and fit for human food.

Prices vary considerably, and unfortunately nearly always with an upward tendency. At present beef is sold at 2.25 pesetas per kilogram (about 14 cents per pound) and mutton at 2.50 pesetas per kilogram (16 cents per pound).

The retail shops are similarly equipped to those in other countries. The meat is delivered to them divided into four quarters and is taken round in covered vans specially constructed for the purpose, with hooks on the sides on which the meat is hung.—(*Julius G. Lay, Consul-General at Barcelona, in Consular Report, August, 1902.*)

German meat inspection.—Ambassador Andrew D. White reports from Berlin, July 12 and 14, 1902, that according to an official proclamation the meat-inspection law will go into force in its entirety on April 1, 1903, with the exception of the section which relates to doing away with the second examination of meat once officially inspected. This paragraph will not go into effect until October 1, 1904.

The following report on the new regulations has been received from Consul-General Richard Guenther, of Frankfort:

As the time is approaching when the new regulations concerning the importation of meat and its transportation in transit through Germany will go into force, it will be well to note the following:

It is prohibited to import into Germany "meat in hermetically sealed boxes and similar vessels, as well as sausages and other mixtures of chopped meat; dog meat; also prepared meat of horses, asses, mules, and other solipeds; meats which have been treated with one of the following substances or with a preparation containing such: Boracic acid and its salts, formaldehyde, hydroxides, and carbonates of alkalies, sulphurous acid and its salts, hyposulphurous salts, fluor-hydrogen and its salts, salicylic acid and its salts, chloride salts, and coloring substances of whatever nature. The latter, however, may be employed for coloring coverings, if not otherwise prohibited."

Fresh meat may be imported into Germany in whole carcasses only, which, if of cattle (calves excepted) or hogs, may be in halves. Calves must not weigh more than 165 pounds. With the carcasses, the pleura, peritoneum, lungs, heart, kidneys, and the udder and lymphatic glands, if of cows, must be naturally connected. Carcasses divided into halves must be packed together and must be so marked and numbered that it becomes at once apparent that the halves belong together.

With cattle (calves excepted), the head or the lower jaw and the masticating muscles must be connected with the carcasses in the natural state; with hogs, the head with the tongue and the head of the windpipe—the brain and the eyes may be missing. With cattle, the head may be separated from the carcass provided the head and the carcass are so marked or numbered that it is at once apparent that they belong together.

With carcasses of horses, asses, mules, and other solipeds, the head, the upper part of the windpipe, and the windpipe, as well as the

whole skin, must be connected in at least one place in its natural state in addition to the pleura, peritoneum, lungs, heart, and kidneys.

Pickled and salted meats, with the exception of ham, bacon, and intestines, may be imported only if the weight of the separate pieces is not less than 8.8 pounds. Smoked meat which has been subjected to a pickling process is to be treated as pickled meat. Meat which has been lawfully inspected in Germany (which fact must be established) and has been exported, is not subject to an official examination if reimported.

The immediate transportation in transit under a customs escort or in bond (if by mail, without these restrictions) is not to be considered as importation under the law; such meat in transit is not subject to the provisions of the law, but it must not remain longer in Germany than is necessary. If meats are stored in a customs warehouse, they are not to be considered as for "immediate transportation."—(*Consular Report, October, 1902.*)

Fees for inspecting meat in Germany.—The Department [of State] has received from Ambassador Andrew D. White, of Berlin, under date of July 19, 1902, copies of the official proclamation with regard to the fees to be charged for the inspection of meat imported into Germany from abroad. A translation of the principal paragraphs follows:

(1) These fees embrace especially compensation for the removal and transport of samples, for notifications, registering in the inspection books, drawing up of certificates, and the traveling on the part of experts that may be necessary.

(2) The fees, apart from the fixed fees for special inspection in paragraphs 4 to 6, amount to:

Description.	Fees.	
A. For fresh meat.	*Marks.*	*Cents.*
(1) Horned cattle (exclusive of calves) per head	2.50	59.5
(2) Calf do	.75	17.8
(3) Hog or wild boar do	.75	17.8
(4) Sheep or goat do	.60	14.2
(5) Horse or other soliped (donkey, ass, mule) do	3.00	71.4
B. For dressed meat (with exception of fat).		
(6) Intestines per kilogram (2.2 pounds)	.01	.24
(7) Bacon do	.02	.47
(8) Other dressed meat do	.025	.6
For any consignment of intestines, at least	.40	9.5
Other dressed meat, at least	.50	11.9

In dissimilar consignments or when, in case of appeals from a test, the inspection has to be carried out for the entire consignment, the fees under B, 6 to 8, are to be doubled.

(3) The preparation of meat for inspection (taking out intestines, detaching fat from the inside, cutting hogs in halves, hanging up or laying out of parts of meat in inspection rooms), if it does not take place through the authorized authorities, will be subject to an additional charge of 20 per cent on the fees already provided.

(4) Fees for the inspection of trichinæ are:

Description.	Fees.	
	Marks.	*Cents.*
(1) For the entire hog or wild boar	1.00	23.8
(2) For a single piece of meat, except bacon (hams, pieces of salt meat, and the like)	.50	11.9
(3) For bacon per piece	.35	8.3

Special fees are not to be levied for the assistants.

(5) Without prejudice to the provisions of paragraph 6, the fee for the chemical inspection of dressed meats, except fat, is 2 pfennigs (0.476 cent); for the chemical inspection of prepared fats, inclusive of previous examination, 1 pfennig (0.238 cent) per kilogram (2.2 pounds). The smallest fee for the chemical inspection of meat is 1 mark (23.8 cents) and for fat 40 pfennigs (9.5 cents) for every package of the consignment. With dissimilar consignments, or when in case of appeal an inspection of the entire consignment is necessary, the fees are to be doubled.

(6) For the chemical inspection of dressed meat, to detect the presence of horse meat, when this is proven by the inspection a fee of 15 pfennigs (3.57 cents) is assessed for every kilogram (2.2 pounds) of the consignment. For the inspection of hams, in consignments of less than 10 pieces, of bacon and of intestines, or of fresh meat, in case of the presence of materials named in section 5, No. 3 of export classification D, a fee of 5 pfennigs (1.19 cents) is assessed under like stipulations for every kilogram (2.2 pounds) of the consignment. The minimum fee for inspection to detect the presence of horse meat shall be 15 marks ($3.57) and for the presence of forbidden materials, 2.50 marks (59.5 cents) per consignment.

(7) The net weight is the basis for computing inspection fees. If it is necessary to ascertain this weight, it is to be computed according to the prescribed customs regulations.

(8) In case the consignment is voluntarily withdrawn on the ground of appeals, the fees fixed in paragraph 2 under B, 6 to 8, and those in paragraph 4 are to be levied only on that part of the consignment in which the inspection has already been made.

In like manner, the fees fixed in paragraph 5 are to be divided in half, if at the time of withdrawal not more than the half of the meat has undergone chemical inspection.

—*Consular Report, October, 1902.*

Meat inspection expenses in Germany.—The Frankfort Zeitung of August 5 contains an analysis of the methods prescribed for assessing official fees for the inspection of lard and meats under the new law of June 3, 1900, which, as has been heretofore explained, will enter into full effect from the 1st of October this year.

The article deals especially with the additional expenses that will be added to the cost of meats, both native and imported, under the new system, and the following deductions are substantially translated from it as of presumable interest in the United States. In respect to lard the Zeitung says:

In a shipment of 1,000 tubs of lard, each containing 12.5 kilograms (27.55 pounds) net, 27 tubs will have to be opened, and from the whole number samples of 250 grams (about half a pound) will be taken. Six of these samples will then be submitted to examination to prove whether they are pure lard and contain no adul-

teration or antiseptic preservative. After this inspection each package in the entire shipment will be stamped with two seals. The cost of each analysis will be 10 marks ($2.38), and for sampling and stamping each package 1 pfennig (0.238 cent), which will amount in all to 75 marks ($17.85).

In respect to small pork shoulders, which weigh on an average 3 kilograms (6.6 pounds)—that is, 100 pieces weighing 300 kilograms (661 pounds)—the 100 pieces would pay for inspection fees as follows:

	Marks.
(a) For the general inspection	7.50=$1.78
(b) Examination for prohibited preserving materials	6.00= 1.43
(c) Examination for trichinæ	50.00=11.90
Total	63.50=15.11

or 21 marks ($5) per 100 kilograms (220 pounds). To this must be added the duty, 17 marks ($4.04), so that a grade of meats the price of which has been during the past five years about 55 marks ($13) per dozen pieces will have to pay in duty and inspection fees 38 marks ($9.04).

The same is true of the full-grown bacon "bellies," which are imported in pieces of 4 to 5 kilograms (8.8 to 11 pounds) weight, and in the meaning of the meat-inspection law would be classed as pickled meat. As such it will be subject to the same charges as the above-cited shoulders, and will cost in fees for 100 pieces weighing net 450 kilograms (992 pounds):

	Marks.
(a) For general inspection	11.25=$2.87
(b) For chemical examination	9.00= 2.14
(c) For inspection for trichinæ	50.00=11.90
Total	70.25=16.91

or 15.50 marks ($3.68) per 100 kilograms (220 pounds). To this amount must be added the duty, 20 marks ($4.76)—in all, 35.50 marks ($8.44) per 100 kilograms (220 pounds) for duty and importation charges.

The net effect of the new system, as illustrated by these examples, will be to restrict the supply of meat and more or less advance its price in the markets of Germany.—(*Frank H. Mason, Consul-General at Berlin, in Consular Report for October, 1902.*)

The price of pork in Germany.—During the past few months the organized butchers of Germany have been clamoring for the abolition of the prohibitive tariff on pork. This meat is an important article of food among the poorer classes of the Empire, and its steady rise in price has resulted in great hardship to them. Prices are higher now than they have been for twenty-five years, and if the present scarcity of pork continues there will undoubtedly be a further advance.

The following table shows the wholesale price per 100 kilograms (220 pounds) of the best quality of live hogs during 1901 and 1902:

City.	1901.	1902.	City.	1901.	1902.
Berlin	$13.24	$14.61	Hamburg	$12.88	$14.55
Breslau	12.65	13.63	Cologne	14.16	15.53
Magdeburg	12.42	14.90	Frankfort	15.17	16.07
Dresden	13.72	14.99	Stuttgart	14.49	16.25

In the retail trade the increase is also very pronounced.

Retail price per kilogram (2.2 pounds).

City.	1901.	1902.	City.	1901.	1902.
Berlin	$0.29	$0.31	Leipzig	$0.29	$0.31
Danzig	.29	.31	Stuttgart	.33	.36
Chemnitz	.31	.36	Munich	.30	.31

In Chemnitz, where depression among the industrial branches has been very pronounced, the retail price of pork has increased 25 per cent.—(*J. F. Monaghan, Consul at Chemnitz, in Consular Report, July, 1902.*)

Meat imports into England.—The English people are the greatest consumers of bacon in the world. The vast majority of the people eat bacon for breakfast at least six mornings out of every seven throughout the year, so it can easily be understood that the total consumption is enormous. As the British people are ceasing to grow wheat, so they are stopping raising hogs and cattle, and have to depend more and more upon outside sources for supplies. In 1901 the value of the bacon imported was $67,950,880, an increase of $23,611,650 in five years. The United States' share was $46,279,255, an increase of $8,819,540 in a year, and of $28,316,080 as compared with 1897. Canada has been making a big bid for this trade. In 1901 she sent over bacon to the value of $4,607,545. Now, while this is a gain of $3,156,130 as compared with 1897, it is an actual decrease, amounting to $769,680, as compared with 1900. The excellence of Canadian bacon can not be disputed. The hogs are fed on peas mostly, and the bacon is well cured, but it is dearer than bacon from the United States, and the American product has within recent years gradually improved in curing and appearance. The English people like mild-cured bacon, and it must be cut in a certain way, and American packers have now become masters in the art of meeting the wishes of their customers over here.

The figures $43,534,195 represent the value of the total importation of fresh beef last year. The value of the contributions of the United States was $33,807,935. Although Argentina can not send live cattle to this country, by reason of the prohibition on account of the foot-and-mouth disease, yet she is steadily climbing up in supplying chilled beef to this market. In 1897 the value of the importations from Argentina was only $640,890, while in 1901 the value was $6,091,230. Canada's proportion was insignificant.

The total value of the importation of hams in 1901 was $22,641,940. Of this the share of the United States was $21,049,080, being an increase of $2,235,510 over 1900. Canada's shipments showed an actual decrease compared with 1900, amounting to $713,795. Curiously, Holland supplies more fresh pork than does any other country, the United States being a good second.—(*James Boyle, Consul at Liverpool, in Consular Report, February, 1903.*)

Price of beef and scarcity of cattle in Belgium.—An article concerning the price of beef and the scarcity of cattle in Belgium recently appeared in the newspaper Le National, of Brussels. As it may be of interest to our exporters of beef and cattle, I quote therefrom:

According to information received from a high official of the agricultural department, the probable increase in the price of beef is caused by the poor crop of Indian corn in the United States, advance in price of American cattle, extensive purchase of cattle by England in Holland—in short, by a series of causes, the effects of which are felt in all countries. In Germany the retail price of beef has increased 10 per cent.

The department of agriculture says it is a mistake to believe that if the frontier were free to Dutch cattle the situation would be improved. The sanitary inspection is not an obstacle, and nothing prevents the introduction of fat cattle. If cattle are dear on our market it is simply because they are also dear in Holland, where they are much in demand by English consumers. In view of the increase in price, a reduction of quarantine is asked for Dutch thin cattle, as it is claimed that quarantine is no longer justified as a sanitary measure, since no epidemic of aphthous stomatitis now exists in Holland. Those who advance such an argument forget that tuberculosis is always prevalent there, and quarantine was established for both diseases. Last year, more than 1,600 animals which arrived at the frontier were sent back to Holland on account of tuberculosis. The entry into Belgium of French cattle will not be authorized, as French cattle suffer from numerous diseases.

—(*George W. Roosevelt, Consul at Brussels, in Consular Report, December, 1902.*)

Meat and dairy products in New Zealand.—I give below a statement of the quantities and value of meats, butter, and cheese exported from New Zealand from March 31, 1901, to March 31, 1902:

Description.	Quantity.	Value.	
Meats:	*Cwts.*		
Frozen	1,871,731	£2,232,385	$10,863,902
Preserved	37,903	125,355	670,040
Butter	219,493	983,224	4,784,860
Cheese	86,476	189,992	924,596

These exports went almost wholly to Great Britain. The increase in the export of butter is very marked, being 20 per cent in quantity and 24 per cent in value.

The dairy industry in New Zealand is advancing rapidly, and the government is doing all it can to promote the trade. Experienced government graders are constantly employed at the principal ports examining the exports of these products and issuing certificates of quality. It is a rare thing in any part of New Zealand to be served with poor butter. The same is true of beef and mutton.

There are no droughts in New Zealand, and it is a fine grazing

country. Cattle are never housed here, as the climate is mild enough for them to be left in the open all the year around.

* * * * * * *

There are steamers running regularly to New Zealand and Australia from New York, and many of them are built to carry meat and dairy products; but they are all English steamers, and on the return voyage go to England, where everything destined for America has to be transshipped, which adds very much to the cost of delivery.

As shown by the figures given, the average cost per pound of the products mentioned is: Frozen meat (including lamb, mutton, and beef), 2½d. (5 cents); butter, 9¼d. (19 cents); cheese, 4¾d. (9½ cents). These figures represent the f. o. b. New Zealand cost.

The quantities of the different kinds of frozen meat exported are:

Mutton:		
Whole carcasses	number	1,585,238
Joints	do	63,617
Lamb	carcasses	1,351,143
Beef	cwts. (of 112 pounds)	312,291
Rabbits, frozen in the skin	number	6,501,997
Hares, frozen in the skin	do	12,260

I am induced to send this report, as I notice that a trial shipment of New Zealand mutton has recently been made to New York which was spoken of very highly by the experts who examined it.—(*L. A. Bachelder, Vice-Consul at Auckland, in Consular Report, May 26, 1902.*)

Slaughtering of cattle for jerked beef in River Plate districts, 1899 to 1902.—Hon. Albert W. Swalm, U. S. consul at Montevideo, Uruguay, transmits, through the Department of State, the following information concerning the slaughter of cattle for jerked beef, or tasajo, for the years 1899 to 1902, inclusive:

The statistics have been given out showing the slaughter of cattle for tasajo, or jerked beef, in the River Plate districts, which include both Uruguay and Argentina. The figures are given for the past four years, as follows:

	Number.
1899	1,422,000
1900	1,309,100
1901	1,297,600
1902	1,669,300

For the season of 1901-2 there were killed in Montevideo 385,400 cattle, and outside 428,000, or a total for Uruguay of 813,400 head. The average price per head was, roundly, $18, Uruguay gold. During the same time the Argentina kill for the same purpose was 460,900 head. The better grade of Argentine cattle are killed and refrigerated for export to Europe, there being several very successful establishments in Argentina. In Uruguay there is not one refrigerating slaughterhouse for export, hence the Uruguayan cattle are used for tasajo, or jerked beef. A company has been formed in Montevideo to handle some 200,000 head of cattle in the modern way, the quarters to find export at the port of Sance, near which the plant is to be established. It has the promise of success in every way.

Exports of animal products from the Transvaal.—A recent consular report gives the following exports of animal products from the Transvaal for the year 1902:

Article.	Quantity.	Value.
Hides .... number..	5,888	$9,835
Mohair .... pounds..	....	4,356
Sheepskins .... number..	18,140	4,000
Wool .... pounds..	102,072	65,758

Sausages in Spain.—Among the oldest and most prominent industries in this district of Spain is the manufacture of sausages. Although the preparation of hams and sausages is also carried on to some extent in the provinces of Asturias, Huelva, and Estremadura, I will confine myself to a few remarks on this trade in the province of Catalonia.

The chief center of the industry is the old town of Vich, situated on an elevated plain on the southern slopes of the Pyrenees. The climate and character of the surrounding territory are particularly well adapted to the rearing of pigs, while the large steam-power factories to be found there are a proof of the thriving nature of the trade. According to statistics the number of pigs slaughtered in Catalonia during 1900 was 114,629. In preparing the meat for the sausages it is first minced, usually by machinery, though in the farm houses it is still done by hand, the peasants claiming that when cut in this way the meat retains more of its moisture and flavor. After the pork is minced and the desired quantity of bacon has been added the necessary proportion of pepper and salt is thrown in—generally 4 per cent of salt. The whole is then well mixed and pressed into a compact mass, which is incased in intestines which have been previously washed clean, all fatty matter having been removed and a small quantity of salt introduced. This operation requires some care in order to insure a vacuum in the cases.

The genuine Vich sausages, which are famed throughout Spanish-speaking countries, are prepared exclusively from lean pork and a small quantity of bacon without admixture of any other kind of meat. As the sausages are made they are placed on tables and wrapped in clean cloths in order to extract any excess of moisture. After a few hours they are hung in the drying room, care being taken that each sausage hangs separately to get the benefit of the circulation of air. Every precaution is taken to keep out the hot, damp, southeast wind known as the sirocco, the effects of which are most prejudicial to the drying process.

The sausages made in the vicinity of Vich are supposed to acquire a special flavor which distinguishes them from those made in other parts. This peculiarity is not due to any special preparation, but is apparently gained during the process of drying, as sausages prepared

in other districts and brought to the plain of Vich to be dried acquire the same distinguishing aroma.

The estimated annual output of the Vich factories is valued at nearly $1,000,000.—(*Julius G. Lay, Consul-General at Barcelona, in Consular Report, May, 1902.*)

Jerked beef exports to Cuba.—The exports of jerked beef from the River Plate establishments to Cuba have been officially reported as follows:

	Metric tons.[a]
1901-1902	8,974.5
1900-1901	9,804.6
1899-1900	6,222.3

Thus for this season there have been sent to Cuba and Porto Rico the goodly quantity of 19,777,182 pounds of meat product, making the voyage of over 7,000 miles chiefly by sailing vessels.

For the same period the slaughter of cattle for jerked beef is officially reported as follows:

	Number.
Montevideo saladeros[b]	348,316
River saladeros	337,500
Uruguayan slaughter	685,816
Buenos Ayres saladeros	169,900
Argentine River saladeros	201,400
Argentine slaughter	371,300
Total	1,057,116

The slaughter for meat extracts, which are all exported to Europe, has been 238,600 head of choice cattle. This makes a total of 1,305,716 for the season, and exceeds that of any year since 1898. These cattle are largely of the mixed-blood class, and the average cost per head, for 3 to 5 year old, has not exceeded $22 in United States gold.—(*Albert W. Swalm, Consul at Montevideo, in Consular Report, October, 1902.*)

Frozen meats and statistics of live stock in Uruguay.—Hon. Albert W. Swalm, United States consul at Montevideo, has informed this Department that "the Congress of Uruguay has pledged the adoption of measures for aiding the establishment of the frozen-meat industry; in fact, has passed a bill to its last stage, and by 1903 the frozen meats, beef, and mutton of that Republic will be found in competition with the American meats of the same class in English and European markets.

"It is conservatively estimated that half a million head of cattle and two and a half million of sheep can be easily supplied for this market annually. The census of Uruguay for 1900 reports the num-

[a] Of 2,204.6 pounds.

[b] A saladero is a salting station.

ber of cattle of all ages at 26,134,896 and sheep at 18,608,717, with a wool clip for that year of 33,000,000 kilos (72,600,000 pounds). These facts may be of interest to American producers, with whom these surplus products will most assuredly come into competition."

Meat, butter, and eggs in Russia.—The recent visit to England of a committee of Russian agriculturists and dealers in live stock to promote the trade in fresh meats and dairy produce has increased the interest in these industries.

It is proposed to establish abattoirs at Baltic ports, with a line of refrigerator steamers which will reach the United Kingdom in fifty hours. These steamers will also carry butter and eggs.

During the past eleven months Russia's export of meats (on the hoof, salted, and fresh) was, including Finland:

Description.	Quantity.		Value.	
	Poods.	*Pounds.*	*Rubles.*	*Dollars.*
Fresh meat (except hog)	44,000	1,588,928	223,000	114,845
Salted, smoked-dried meat (except hog)	9,000	325,008	50,000	25,750
Swine's flesh			1,285,000	661,775
Cattle (cows and oxen)	5,000	180,560	320,000	164,800
Boars (hogs and pigs)	58,000	2,094,496	2,534,000	1,305,010
Sheep and lambs	55,000	1,986,160	242,000	124,630

It is estimated that at an average price of $5 per pood (36 pounds) an immense business can be built up in England. The export of Russian eggs has increased in value from 3,000,000 rubles ($1,545,000) in 1875 to 30,000,000 rubles ($15,450,000) in 1901, and the British branch of the trade is capable of much greater development. The line of refrigerator steamers would enable Russia to compete with Denmark's large export of butter to England. The Russian authorities are well aware of the necessity of improving the quality of these commodities, in order to give them a stronger position in British markets, and, to this end, are devising comprehensive schemes for the better breeding of cattle and for the production of first-class dairy and other rural articles of food.—(*W. R. Holloway, Consul-General at St. Petersburg, in Consular Report, May, 1902.*)

Russia's export of poultry.—A special committee has been appointed by the agricultural department to promote the exportation of beef, eggs, fowls, butter, etc., from Russia to the English markets. The president of the committee has visited England and investigated the markets there and has found an excellent opening for Russian products.

From the data given, England imported last year eggs to the value of $25,830,000, of which the import from Russia amounted to $5,675,000. In regard to poultry, England appears to be one of the largest consumers in Europe. In 1901 it imported poultry and game to the value

of $4,609,475, the greater part of which came from France, and then from Russia, Belgium, Holland, and Denmark.

In 1901 the exports of Russia in this line amounted to 46,622,000 rubles, or $23,311,000, classified as follows:

Description.	Value.	
	Rubles.	*Dollars.*
Eggs	35,392,000	17,696,000
White and yolk of eggs	1,839,000	969,500
Down and feathers	150,000	75,000
Dressed poultry	2,513,000	1,256,500
Live geese	5,560,000	2,780,000
All other live poultry	1,168,000	584,000

—(*Samuel Smith, Consul at Moscow, in Consular Report, October, 1902.*)

Numbers of live stock in United Kingdom.—The sixteenth annual report of this bureau, that for 1899, gives a table showing the numbers of live stock in the United Kingdom for the years 1891 to 1899, inclusive. The table herewith, which is compiled from the reports of the board of agriculture of Great Britain, gives the numbers of the different species of farm animals in the several countries of the United Kingdom for the years 1900, 1901, and 1902:

Numbers of live stock in the United Kingdom, 1900, 1901, and 1902.

Country and year.	Horses.	Cattle.	Sheep.	Hogs.
England:				
1900	1,152,321	4,848,698	15,844,713	2,021,422
1901	1,161,914	4,791,535	15,548,057	1,842,133
1902	1,155,361	4,611,937	15,034,479	1,956,158
Wales:				
1900	153,284	758,386	3,432,516	228,097
1901	154,624	743,078	3,427,734	212,971
1902	154,114	721,874	3,462,698	215,283
Scotland:				
1900	194,538	1,198,086	7,314,997	132,413
1901	194,893	1,229,281	7,401,409	124,821
1902	195,314	1,122,165	7,268,529	128,126
Ireland:				
1900	491,156	4,608,550	4,386,876	1,268,521
1901	491,430	4,673,323	4,378,750	1,219,135
1902	509,284	4,782,204	4,215,740	1,327,592
Isle of Man and Channel Islands:				
1900	9,116	41,189	75,624	13,263
1901	8,840	40,607	73,939	12,062
1902	8,890	38,798	74,915	12,605
Totals:				
1900	2,000,415	11,455,009	31,054,726	3,363,716
1901	2,011,701	11,477,824	30,829,889	3,411,122
1902	2,022,963	11,376,969	30,056,631	3,639,764

Loss of live stock in Australia.—The Agricultural Journal of Cape Town, South Africa, of the date of August, 1902, says: "Australia has lost by drought since 1892 upward of 20,000,000 head of stock, of which 15,000,000 has been lost since 1899. The present season is the worst ever known in the Island Continent."

Live stock statistics of France.—The number of live stock in France for the year 1901 was as follows: Horses, 2,926,382, or 23,319 more than in 1900; mules, 200,310, or 4,692 fewer than in 1900; asses, 354,642, a decrease from 1900 of 1,597; cattle, 14,673,810, an increase of 152,978; sheep, 19,673,840, a decrease of 509,879; hogs, 6,758,198, an increase of 17,793; goats, 1,529,280, a decrease of 28,645. The London Live Stock Journal says: "Cattle in France in the last ten years have increased by over a million, while sheep have declined in number by more than 7,000,000."

Exports of animals and animal products from Argentina.—The exports of animals and animal products from Argentina for the years of 1901 and 1902 are shown in the following statement:

Article.	1901.	1902.
Cattle .... number..	119,189	118,303
Sheep .... do....	25,746	112,501
Frozen beef .... metric tons..	43,497	70,018
Frozen mutton .... do....	63,013	80,073
Jerked beef .... do....	24,296	22,304
Butter .... pounds..	3,322,391	9,075,000

Of the cattle exported, Uruguay took 47,884 head and Brazil took 28,923.

The growth of the exports of frozen beef from Argentina may be seen from the following statement:

Year.	Metric tons.	Pounds.
1897	4,241	9,349,709
1898	5,867	12,934,388
1899	9,079	20,015,563
1900	24,590	54,211,114
1901	43,497	95,893,486
1902	70,018	154,361,683

With the exception of 421,079 pounds shipped to France in 1897 and 134,481 pounds shipped to the same country in 1898, these exports of frozen beef all went to the United Kingdom.

Wool production in Australasia.—Consul-General J. P. Bray, of Melbourne, under date of December 19, 1902, reports that owing to the drought prevailing in Australia there is a large decrease in this

season's supply of wool—estimated at over 200,000 bales. At recent sales prices of both Merino and crossbred wools advanced from 20 to 30 per cent. The total Australasian wool clip of the past two seasons was as follows:

State.	1900-1901.	1901-1902.
	Bales.	*Bales.*
Victoria	220,000	227,000
New South Wales	708,000	763,000
Queensland	157,000	143,000
South Australia	110,000	103,000
Tasmania	26,000	26,000
Western Australia	29,000	32,000
Total	1,250,000	1,294,000
New Zealand	396,000	406,000
Total for Australasia	1,646,000	1,700,000

The estimated clip for 1902–03 is placed at 1,500,000 bales—a decrease of 200,000 bales. This decrease, adds Mr. Bray, has not materially affected the exports to the United States from Victoria, as the number of bales invoiced at the consulate-general is well up to that of last season—viz, 20,000 bales—and should reach 25,000 or 26,000 bales.—(*Consular Report, April, 1903.*)

Australian wool for the United States.—Consul-General Bray, of Melbourne, under date of February 15, 1902, reports that the total shipments of wool from Melbourne to the United States during the season 1901–02 amounted to 28,258 bales [of 300 pounds] against 26,942 in the previous season, or an increase of 1,316 bales. The consul at Sydney reports shipments to the amount of 7,535 bales from that port, making a total of 35,793 bales shipped from Australia to the United States.—(*Consular Report, May, 1902.*)

Wool trade in Australia.—Australia has long been noted for the excellent class of its sheep. Formerly the best wool was produced in Spain, the mild and equable climate favoring it. New South Wales was first stocked from Spanish flocks, and it is said that in this climate the wool has gradually grown softer, more elastic, and longer than that produced in Spain, and so has gained a high reputation.

In 1891 there were 61,831,416 sheep in New South Wales, the greatest number on record, and it is considered that the country at that time was overstocked. The total amount of wool said to have been produced in this State in 1891 was 375,600,667 pounds. In 1894 there were 4,000,000 fewer sheep, but 4,000,000 pounds more wool. There has been an almost constant decrease in the number of sheep down to the present time. Owing to the drought, the past year has been the most disastrous of all.

The total production of wool in New South Wales for 1900 is stated at 237,659,727 pounds, which is less by 137,940,940 pounds than in 1891.

The export of wool from the Commonwealth in 1900 was 409,394,600 pounds; from New Zealand, 156,174,000 pounds—total from Australasia, 565,568,600 pounds. The estimated value of the clip was about $88,500,000.

The sales at Sydney (387,358 bales [300 pounds each]) were disposed of as shown below:

	Bales.
To continent of Europe	211,701
To England	92,910
To America	7,978
To Japan	3,331
To local scourers	71,438

The average price realized was £9 11s. ($46.47) per bale.—(*Orlando H. Baker, Consul at Sydney, October 25, 1902.*)

Imports of Angora goatskins.—Since July 1, 1902, the Treasury Department has been recording separately the imports of Angora goatskins, and Hon. O. P. Austin, chief of the Bureau of Statistics, furnishes the following statement for the last six months of the year 1902:

Imports of goatskins.

Period.	Pounds.	Value.
July to September	78,872	$13,005
October to December	97,259	15,439
Total	176,131	28,444

This indicates an annual importation of 352,262 pounds, valued at $56,888. Angora skins with mohair attached are admitted free of duty.

Imports of mohair at Bradford, 1897 to 1902.—As the production of mohair increases year by year the Bradford (England) trade expects to be delivered from those violent fluctuations in prices which were characteristic of mohair when it was less in production. The following table gives in pounds the imports of mohair at Bradford for the years 1897 to 1901 and eleven and one-half months of 1902:

Imports of mohair, 1897 to 1902.

Year.	Mohair.		Year.	Mohair.	
	Turkey.	Cape.		Turkey.	Cape.
1897	56,000	25,800	1900	44,837	15,896
1898	55,694	20,881	1901	50,519	20,222
1899	70,978	26,121	1902	59,981	31,000

The prices ruling at Bradford for each month of the year 1902, for both Turkey and Cape hair, are shown in the following table:

Month in 1902.	Turkey average.	Cape firsts.	Month in 1902.	Turkey average.	Cape firsts.
	d.	*d.*		*d.*	*d.*
January	14-16	11¾-12¼	July	15-16¾	11½-12½
February	14-15¾	11¾-12½	August	14-16½	11¾-12½
March	14-15½	11¾-12½	September	14-16	11¾-12¼
April	15-16¼	11¾-12	October	14-15	12-12¼
May	15-16¼	11¾-12¼	November	14-15	11¾-12½
June	15-17	11½-12½	December	14-15	12-12¾

Should sheep eat salt?—Experiments have recently been made in France for the purpose of ascertaining the nutritive value of salt for sheep. Three groups of sheep were otherwise fed with the same food, but the first lot received no salt, each of the second lot half an ounce of salt daily, and each of the third lot three-quarters of an ounce daily (the ounce being reckoned at about 28½ grams). The result was that the sheep of the second group each gained in weight 4½ pounds more than those which received no salt and about 1¼ pounds more than those which received over half an ounce. Moreover, the sheep which received salt produced 1¾ pounds more wool, and of a better quality, than those which received no salt. The report does not state how long the experiments were continued.

Cattle food from sugar cane in the West Indies.—Experiments have been made by George Hughes, a director of one of the largest estates in the British West Indies, which will result in the formation of a profitable industry in the manufacture of a new cattle food, to which the name "molascuit" has been applied. It is a composition of molasses and cush-cush of bagasse, the finest part of the fiber of sugar cane. Fifty per cent of cush-cush is digestible and nutritious. The proportions of the composition are 80 to 85 per cent of molasses and 15 to 20 per cent of cush-cush. This composition is air-dried and may be made by utilizing the gases from the factory furnace. When ready for the market, it presents the appearance of very finely ground oil cake. There is another preparation in use known as "molassine meal," made from beet-sugar molasses and a vegetable matter, which sells at about $32 per ton and has a very good demand. Molascuit can be sold at about 20 per cent less and can be shipped in bags. As a by-product of sugar it might be of considerable value to planters who would thus have two ways of disposing of molasses—in making rum and molascuit. The matter has been brought before the board of agriculture with a view of getting the preparation officially recognized so that uniformity may be obtained. I have inquired of sugar planters if they could afford to use bagasse for this purpose in preference to utilizing it for fuel, and was told that only a very small por-

tion, and that the finest part of the fiber, of bagasse was required in the preparation, and that it would not interfere to any extent with the use of bagasse as fuel. They also acknowledge its value as a food for cattle and as a new industry for the colonies.—(*George Sawter, Consul at Antigua, in Consular Report, August, 1902.*)

Milk powder in Sweden.—Although I have already made several short reports on this subject, in view of the numerous inquiries for additional information by interested persons in the United States, I feel justified in again referring to it.

Dr. Ekenberg explained that chiefly skimmed milk would be utilized, as powder made from pure milk does not keep so well. The maximum cost of production (for coal, oil, and labor), he said, is 1 öre per liter (about 1 cent per gallon) of skimmed milk exsiccated.

As to its chemical composition and the profit considered possible to be derived from the manufacture of milk powder in Sweden, I quote the following article, which yesterday appeared in a Gothenburg paper:

By improvement of the milk separators, the skimmed milk is now nearly entirely free from fat, and is therefore less useful for many purposes. During the year 1900 the total quantity of unskimmed milk received and weighed in by the creameries in this country amounted to 769,607,973 kilograms (1,696,677,737 pounds), from which was produced 26,114,018 kilograms (57,570,963 pounds) of butter and 7,434,455 kilograms (16,390,000 pounds) of cheese. Besides this the creameries sold 72,672,603 kilograms (160,214,000 pounds) of unskimmed milk. The quantity of skimmed milk corresponding to the butter produced is about 600,000,000 kilograms (1,322,760,000 pounds). If this were transformed into milk powder according to Dr. Ekenberg's method, 60,000,000 kilograms (132,276,000 pounds) of milk powder would be produced. The composition of the milk powder is, according to a statement which Commercial Chemist John Landin made in a lecture before the Swedish Technological Students' Club, on the average, as follows:

	Per cent.
Albuminous matter	36
Sugar of milk	49
Fat	1
Milk salts	7.5
Moisture	6.5

If we, from a nutritive point of view, pay attention only to the albuminous matter, we find that 1 kilogram (2.2046 pounds) of milk powder equals 1.8 kilograms (2.48 pounds) of boneless meat from neat cattle, which usually contains, on the average, 20 per cent of albuminous matter and 70 to 75 per cent of water. The white of an egg contains about 12.6 per cent of albumen and 85.7 per cent of water; therefore the nutrimental value of the milk powder is nearly three times as great as the white of an egg. Owing to the large quantity of sugar in the milk powder, and the milk salts which are physiologically important in the formation of the blood, the real value is comparatively still higher. At a price of 2 to 3 öre per liter (2 to 3 cents per gallon) for the skimmed milk, it has been stated that the milk powder can with good profit be sold for 70 öre per kilogram (8.58 cents per pound), and this price is likely to be paid, because the price of skimmed milk in France, England, Belgium, and parts of Germany is above 7 öre per kilogram (1.9 cents per 2.2046 pounds), and 1 kilogram of milk powder dissolved in water will yield 10 kilograms of milk of the same composition as the skimmed milk.

The whole yearly output of skimmed milk from our creameries, corresponding to 60,000,000 kilograms of milk powder, would, utilized in this form, represent a value of 40,000,000 kroner ($10,720,000), or more than the value of our whole yearly export of butter, which in 1900 was 36,960,230 kroner ($9,905,341).

Among general uses for the milk powder have been mentioned: For bread (instead of using milk); for making puddings, sauces, etc.; for mixing in chocolate, preserves, cakes, biscuits, confectionery, etc. It would also be an important article of provision for the army and navy, for prisons, poorhouses, hospitals, and other public institutions.

I am not in a position myself to make an estimate of the value of the invention, nor can I vouch for the correctness of the above calculations as to the commercial value of the milk powder.—(*Robert S. S. Bergh, Consul at Gothenburg, in Consular Report, August, 1902.*)

Persian lamb, Gray Crimmer, and Astrakhan.—The Persian lamb, as its name indicates, is the young of the Persian sheep, which is said to be the most ancient breed known. The color of this sheep is black, brown, or white, and the wool is very coarse and dense. The lamb has a very soft skin, and its wool is beautifully curled. The prevailing color of the lamb skins is black, but a few are mottled with white. All, however, are dyed black before going into market for final consumption.

This skin is usually known by the name Persian lamb or Astrakhan. Although it is not the real Astrakhan, as we shall presently see, there are no essential differences between the Persian lamb skin and the Astrakhan which would interest the consumer. The Persian lamb skin or "fur" is one of the few that are worn by both men and women. It goes into the manufacture of caps, muffs, coat facings, and such like articles. The value of the raw skin varies all the way from $1.75 to $3.75. In some years, when fashions demand them, as many as 700,000 are taken. The Persian lamb skin, unlike many other lamb skins, will take a brilliant dye.

In this connection mention may well be made incidentally that the Afghan lamb is similar in many respects to the Persian lamb, except that the wool is coarser and the curl larger, while the price ranges about 20 per cent lower.

There is a prevalent idea that in order to obtain the best Persian lamb skin or Astrakhan it is necessary to kill the mother before the lamb is born. Henry Poland, author of Fur-Bearing Animals in Nature and Commerce, says this idea probably arose from the fact that the skins of lambs whose mothers died before the lambs were born are saved and are of great value, looking, when dyed, like watered silk. This lamb is called a "slink."

The Crimmer, or Crimean lamb, derives its name from the Crimean Peninsula. Some of these skins are black, but the great majority are gray. This gray color varies greatly, even to almost white. The curl also varies greatly, sometimes being large and bold and again small. The annual supply depends upon the demands of fashion.

The average is about 70,000. The value ranges from about 85 cents to $1.85. Usually these skins are for children's wear, but in England they find use in ladies' capes and caps, cavalry saddlecloths, etc.

It is stated above that the Astrakhan is often called Persian, and the black Crimmer is usually called Astrakhan, or Persian lamb.

The Astrakhan "fur" derives its name from the province of Astrakhan, in southwestern Russia, where somewhere near 600,000 skins are produced annually. Let us quote here from The Industries of Russia, an official Russian document, as translated by John Martin Crawford:

> Among the breeds of sheep which furnish fine lamb skins, called smoushka, the first place belongs to the Karakoul breed of the Turkistan. The skins of the newborn lambs of the Karakoul type have a black, glossy wool, prettily curled, and which is very durable. These qualities render the Karakoul skins very dear. They serve for adorning winter dresses, and are the fur known as Russian Astrakhan. A good skin costs from 10 to 15 rubles. The Karakoul sheep is of average size, with small horns, drooping ears, a tail fat at the root, and with gray or black wool. During late years the ministry of imperial domains and some farming societies have this breed of sheep brought from Turkistan for improving other breeds, and especially those of the Reshetilov type, which also give good lamb skins.

The prices of these skins range between 16 and 48 cents, and in their raw state go almost wholly to the great Russian market of Nishni-Novgorod, where they are dressed and dyed black in such brilliancy as to be unequaled in Europe. The finished skins are used principally in Canada and the United States.

This lamb is very small, and its skin is usually brown, although it is sometimes white or black. Only the very young lamb skins are valuable as "furs." The larger ones are used, however, as coat linings.

An imitation of the Astrakhan is made from mohair, the fleece of the Angora goat, which is so perfect in deception as to defy detection except by the skillful eye. It is as durable as Astrakhan, and the dye, which is perfectly fast, gives it all the brilliancy of the real article.—G. F. T.

The musk ox.—The musk ox which was referred to in the Eighteenth Annual Report of this Bureau as being the only one in the United States died in the zoological gardens of New York City on August 17. It was announced that its death was due to pneumonia. This musk ox was presented to these gardens by Hon. W. C. Whitney, former Secretary of the Navy.

STATE SANITARY OFFICERS HAVING CHARGE OF LIVE-STOCK MATTERS.

ALABAMA ....Dr. W. H. Sanders, Montgomery, State health officer.
Dr. C. A. Cary, Auburn, professor of veterinary science.

ARIZONA ....H. Harrison, Phœnix, secretary live stock sanitary commission.
Dr. J. C. Norton, Phœnix, veterinarian.

ARKANSAS ....Dr. R. R. Dinwiddie, Fayetteville, veterinarian to State experiment station.

CALIFORNIA ....Dr. W. P. Matthews, Sacramento, secretary State board of health.
Dr. Charles H. Blemer, Sacramento, State veterinarian.

COLORADO ....B. H. Du Bois, Denver, president State veterinary sanitary board.
Dr. J. N. Hall, State capitol, Denver, secretary State board of health.
Dr. A. B. McCapes, Denver, State veterinary surgeon.
E. McCrillis, capitol building, Denver, secretary State board of stock inspection commissioners.

CONNECTICUT........Dr. C. A. Lindsley, New Haven, secretary State board of health.
Heman O. Averill, capitol, Hartford, commissioner for domestic animals.

DELAWARE...........Dr. Alexander Lowber, secretary State board of health, Wilmington.
Dr. H. P. Eves, instructor in veterinary science, Delaware College, Newark.

FLORIDA ....Dr. Joseph Y. Porter, Key West, secretary State board of health.
Dr. Charles F. Dawson, Lake City, professor of veterinary science.

GEORGIA ....O. B. Stevens, Atlanta, commissioner of agriculture.

IDAHO...............J. C. Dressler, Boise City, State sheep inspector.

ILLINOIS ....Dr. J. A. Egan, Springfield, secretary State board of health.
Dr. C. P. Lovejoy, Princeton, State veterinarian.
Charles E. Miller, Springfield, secretary board of live stock commissioners.

INDIANA.............Dr. J. N. Hurty, Indianapolis, secretary State board of health.
Dr. A. W. Bitting, Lafayette, State veterinarian.

INDIAN TERRITORY..

IOWA ....Dr. Paul O. Koto, Forest City, State veterinary surgeon.
Dr. J. F. Kennedy, Des Moines, secretary State board of health.

KANSAS ....Dr. N. S. Mayo, Manhattan, professor of veterinary science.
Dr. Charles Lowry, Topeka, secretary State board of health.
F. H. Chamberlain, Sedan, secretary live stock sanitary commission.

KENTUCKY ....Dr. J. N. McCormack, Bowling Green, secretary State board of health.
Dr. F. T. Eisenman, Louisville, State veterinarian.

LOUISIANA ---------- Dr. Will R. Harman, New Orleans, secretary State board of health.
Dr. W. H. Dalrymple, Baton Rouge, veterinarian to State experiment station.

MAINE ------------- Dr. A. G. Young, Augusta, secretary State board of health.
F. O. Beal, Bangor, cattle commissioner.
John M. Deering, Saco, cattle commissioner.
F. S. Adams, Bowdoinham, cattle commissioner.

MARYLAND --------- Dr. John S. Fulton, 10 South street, Baltimore, secretary State board of health.
Dr. H. A. Meisner, Merchants' National Bank, Baltimore, chief veterinary inspector.
Wade H. D. Warfield, Merchants' Bank building, Baltimore, secretary live stock sanitary board.

MASSACHUSETTS ---- Dr. Samuel W. Abbott, Boston, secretary State board of health.
Dr. Austin Peters, Boston, chief of the cattle bureau of the State board of agriculture.

MICHIGAN ---------- Dr. Henry B. Baker, Lansing, secretary State board of health.
Dr. F. C. Wells, Warren, State veterinarian.
H. H. Hinds, Stanton, president State live stock sanitary commission.

MINNESOTA --------- Dr. H. M. Bracken, St. Paul, Pioneer Press building, secretary State board of health.
Live stock sanitary board: John J. Furlong, Austin; W. W. P. McConnell, St. Paul; Dr. Charles E. Cotton, Minneapolis (veterinarian); Dr. H. M. Reynolds, St. Anthony Park, veterinarian; Forest Henry, Dover.

MISSISSIPPI -------- Dr. John F. Hunter, Jackson, secretary State board of health.
Dr. J. C. Robert, agricultural college, professor of veterinary science.

MISSOURI ---------- Dr. William T. Morrow, Kansas City, secretary State board of health.
Dr. D. F. Luckey, Columbia, State veterinarian.
George B. Ellis, Columbia, secretary State board of agriculture.

MONTANA ---------- Board of stock commissioners: One for each county.
W. G. Preuitt, Helena, secretary live stock commission.
John T. Murphy, Helena, president live stock commission.
Dr. M. E. Knowles, Helena, State veterinarian.
Dr. E. D. Nash, Helena, deputy State veterinarian.

NEBRASKA --------- Dr. W. A. Thomas, Lincoln, State veterinarian.
H. R. Corbet, Lincoln, secretary State board of health.

NEVADA ------------ Dr. W. H. Patterson, Reno, secretary State board of health.

NEW HAMPSHIRE --- Dr. Irving A. Watson, Concord, secretary State board of health.
N. J. Bachelder, Concord, secretary board of cattle commissioners.

NEW JERSEY ------- Dr. Henry Mitchell, Trenton, secretary State board of health.
Franklin Dye, Trenton, secretary tuberculosis commission

NEW MEXICO ------ Dr. W. G Hope, Albuquerque, secretary Territorial board of health.
J. A. La Rue, East Las Vegas secretary cattle sanitary board.
Harry F Lee, Albuquerque, secretary sheep sanitary board.

NEW YORK	William E. Johnson, Albany, secretary to the commissioner of health.
NORTH CAROLINA	Dr. Richard H. Lewis, Raleigh, secretary board of health.
	Dr. Tait Butler, Raleigh, State veterinarian.
	S. L. Patterson, commissioner of agriculture.
NORTH DAKOTA	Dr. L. Van Es, Fargo, State veterinarian.
	Dr. H. H. Healey, Grand Forks, secretary board of health.
OHIO	Dr. J. C. Crossland, Zanesville, president State board of health.
	Dr. C. O. Probst, Columbus, secretary State board of health.
	T. E. Cromley, Ashville, president State board of agriculture.
	W. W. Miller, Columbus, secretary State board of agriculture.
	Dr. Paul Fischer, Columbus, State veterinarian. (Board of agriculture is also live stock commission.)
OKLAHOMA	Z. E. Beemblossom, Guthrie, secretary live stock sanitary commission.
	Dr. E. E. Cowdrick, Enid, superintendent of board of health.
OREGON	Dr. William McLean, Portland, State veterinarian.
PENNSYLVANIA	Dr. Benjamin Lee, 1532 Pine street, Philadelphia, secretary State board of health.
	Dr. Leonard Pearson, 3608 Pine street, Philadelphia, State veterinarian.
RHODE ISLAND	Dr. Gardner T. Swarts, Providence, secretary State board of health.
	John S. Pollard, veterinarian State board of agriculture.
SOUTH CAROLINA	Dr. G. E. Nesom, Clemson College, State veterinarian.
	Dr. James Evans, Florence, secretary board of health.
SOUTH DAKOTA	Dr. T. W. Moffitt, Deadwood, secretary State board of health.
	Dr. J. P. Foster, Huron, State veterinary surgeon.
	Dr. O. W. Stanley, Sioux Falls, deputy State veterinary surgeon.
	Dr. C. M. Morgan, Armour, deputy State veterinary surgeon.
TENNESSEE	Dr. J. A. Albright, Somerville, secretary State board of health.
	Dr. J. W. Scheibler, 147 Court street, Memphis, State veterinarian.
	Mr. R. H. Kittrell, Nashville, State live stock inspector.
TEXAS	Dr. George R. Tabor, Austin, State health officer.
	Hon. Robert J. Kleberg, Corpus Christi, secretary sanitary live stock commission.
UTAH	Dr. T. B. Beatty, Salt Lake City, secretary State board of health.
	Lewis A. Merrill, Logan, professor of veterinary science.
VERMONT	H. D. Holton, Brattleboro, secretary board of health.
	Victor I. Spear, Randolph, secretary cattle commission.
VIRGINIA	Dr. Paulus A. Irving, Richmond, secretary board of health.
	Dr. J. G. Ferneyhough, Blacksburg, State veterinarian.
WASHINGTON	Dr. Elmer H. Heg, North Yakima, secretary board of health.
	Dr. S. B. Nelson, Pullman, State veterinarian, experiment station.
WEST VIRGINIA	Dr. A. R. Barbee, Point Pleasant, secretary State board of health.
	J. O. Thompson, Charleston, secretary board of agriculture.
WISCONSIN	Dr. Evan D. Roberts, Janesville, State veterinarian.
	Dr. U. O. B. Wingate, Milwaukee, secretary board of health.
WYOMING	Dr. George T. Seabury, Cheyenne, State veterinarian.
	Ora Haley, president board of live stock commissioners.

IMPORTS AND EXPORTS OF ANIMALS AND ANIMAL PRODUCTS.

By John Roberts,
Editorial Clerk, Bureau of Animal Industry.

EXPORTS.

The serious insufficiency in our domestic meat supply in 1902 had its inevitable effect upon the exports of meat products for that year, and the latter make up such a large proportion of the total trade in animals and animal products that the result was a deficiency in the annual total, the first one to be recorded since 1897. The statement given below, which is compiled from the reports of the Bureau of Statistics, Treasury Department, shows there was a large falling off in the trade of last year, the total being less, in fact, than it was three years ago, and, when compared with 1901, the deficit amounts to no less than $41,581,649.

The total value of the domestic exports of all kinds in 1902 was $1,360,701,935, that for 1901 was $1,465,375,860, so the deficiency from all sources was $104,673,925. If the above-mentioned shortage of $41,581,649 in the animal industry is deducted from this amount, there will be left $63,092,276 to represent the deficiency from all other sources; thus the falling off in the animal trade applies also, though in somewhat lesser degree, to all other products and manufactures.

The annual totals of our domestic exports of animals and animal products for the past ten years, with the amount of gain or loss, respectively, in each year, are as follows:

Value of exports of animals and animal products 1893–1902.

Year.	Value of exports.	Gain (+) or loss (−).	Year.	Value of exports.	Gain (+) or loss (−).
1893	$196,243,366	−$28,288,913	1898	$237,952,127	+$23,551,664
1894	215,462,956	+ 19,219,590	1899	256,285,487	+ 18,332,350
1895	219,492,191	+ 4,029,135	1900	271,826,854	+ 15,541,367
1896	217,048,412	− 2,443,779	1901	295,786,642	+ 23,959,788
1897	214,400,463	− 2,647,949	1902	254,204,993	− 41,581,649

The decline in 1902 was a general one, affecting almost all the articles on the list, but the deficit was not very serious except in a few items, the chief of which were: Cattle, which fell off to the extent of about $12,000,000; bacon, which shrank a like amount, and fresh beef, which totaled in round figures $7,000,000 less than in 1901.

There were lesser deficiencies in other meat products, and although some of the remainder held their own and one or two actually increased, it will be seen that the decline is almost wholly chargeable to the shortage and high prices which prevailed in the meat industry during the greater part of the year, particularly as regards live cattle and fresh beef.

There was also a marked falling off in dairy products, but the business done in these is small compared with that in meat products.

There were, as above indicated, increases in a few of the items. The canned-beef industry received a strong impetus, there being an excess of upward of $3,000,000 over the figures of 1901. The only other meat product that exceeded the total of the previous year was hams, which gained $1,500,000. There was an advance of about 5 per cent in the leather trade, the gain in upper leather and in boots and shoes being the most prominent.

The detailed list of our domestic exports of animal origin for 1902 is as follows:

Quantities and values of animals and animal products exported from the United States in the calendar year 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article.	Quantity.	Value.
Animals:		
Cattle .... number..	327,118	$24,301,969
Hogs .... do....	4,582	47,186
Horses .... do....	60,694	6,086,012
Mules .... do....	16,306	1,744,192
Sheep .... do....	235,497	1,492,484
All other, including fowls	....	167,450
Bones, hoofs, horns, etc	....	171,320
Eggs .... dozens..	1,749,350	367,034
Feathers	....	189,624
Glue .... pounds..	2,830,128	275,403
Grease, grease scraps, etc	....	2,370,674
Hair and hair manufactures	....	669,477
Hides and skins (other than furs) .... pounds..	10,991,603	1,025,157
Leather and leather manufactures:		
Sole leather .... do....	37,057,483	6,720,966
Upper leather	....	15,058,727
Other leather	....	1,040,703
Boots and shoes	....	6,470,412
Harness and saddles	....	339,999
Other leather manufactures	....	920,265
Meat products:		
Beef—		
Canned .... pounds..	81,362,981	8,384,454
Fresh .... do....	242,015,093	25,028,304
Salted, etc .... do....	47,198,997	3,375,401
Tallow .... do....	21,365,465	1,330,604
Bacon .... do....	270,141,141	27,101,431
Hams .... do....	224,982,389	26,151,091

Quantities and values of animals and animal products exported from the United States in the calendar year 1902—Continued.

Article.	Quantity.	Value.
Meat products—Continued.		
Pork—		
Canned .... pounds..	13,044,954	$1,240,331
Fresh .... do....	31,171,784	2,764,950
Salted, etc .... do....	98,262,179	9,404,635
Lard .... do....	504,153,355	50,869,699
Lard compounds .... do....	36,862,459	2,889,476
Lard oil, etc .... gallons..	598,686	465,277
Mutton .... pounds..	3,790,019	319,327
Oleo oil .... do....	108,164,293	10,443,419
Oleomargarine .... do....	6,318,322	681,431
Poultry and game	....	847,430
Sausage and sausage meats .... pounds..	6,328,527	672,770
Sausage casings	....	1,755,293
All other meat products	....	4,487,623
Dairy products:		
Butter .... pounds..	8,959,316	1,681,723
Cheese .... do....	19,095,438	2,109,347
Milk	....	1,090,051
Wool:		
Raw .... pounds..	445,702	63,814
Manufactures	....	1,588,058
Total	....	254,204,993

IMPORTS.

The animals and animal products imported by the United States during the calendar year 1902 were valued at $127,909,594. This is the largest total since 1897, when the immense quantity of wool products purchased from abroad in that year—aggregating in value $93,863,761—raised the total imports to $159,411,989. The excess of last year over 1901 was $14,723,537. The chief contributors to this amount were wool and wool manufactures, considerably more than half of it being taken up by these two items. The value of the raw wool (which also includes mohair, camel's hair, etc.) imported in 1902 was $19,590,227, while the amount for 1901 was $14,017,432, showing an increase of $5,572,795. The manufactures of wool imported last year were valued at $18,771,774, against $15,604,532 the year before, the increase in 1902 being $3,167,242. A number of other products showed increased figures also, the most prominent being hides and skins (but not goatskins or hides of cattle), the value of our imports of which for last year was $16,689,172, the figures for 1901 being $14,297,816, or $2,391,356 less. There was an increase of over a million dollars in meat products, strange to say, but the previous business had been of small account, and nearly the entire increase mentioned was, it may be said, in miscellaneous meat products—not meat or meat extracts. There were also appreciable increases in bristles, hair and hair manufac-

tures, cheese, and horses, and slight ones in sausage casings, grease and oils, miscellaneous live animals, and glue.

The most important decreases occurred in leather, for which we paid $5,051,361 in 1902, as against $5,507,377 the previous year, or a decrease of $456,016, and cattle, which cost us $373,292 less than in 1901. There were slight decreases also in feathers and hide cuttings.

The table following shows the value by articles of our imports of animal origin for the last four years, arranged in comparative form:

Table showing the value of animals and animal products imported into the United States for the calendar years 1899–1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article imported.	1899.	1900.	1901.	1902.
Cattle	$2,235,373	$1,871,546	$1,942,605	$1,569,313
Horses	581,928	886,811	1,236,709	1,745,868
Sheep	1,305,063	1,260,132	990,299	1,049,281
All other animals, including fowls	282,383	138,649	379,975	622,945
Bones, hoofs, horns, etc	988,502	1,031,725	893,537	936,553
Bristles	1,871,010	1,935,289	1,666,747	2,458,481
Eggs	24,628	7,862	12,041	52,547
Feathers, crude	1,991,304	1,397,334	2,001,498	1,916,125
Glue	528,765	491,190	449,769	559,415
Grease and oils	821,378	673,951	866,696	1,038,571
Hair and hair manufactures	2,477,332	2,065,002	1,867,472	2,453,497
Hides and skins (other than furs):				
Goatskins	20,992,949	19,008,097	25,265,670	24,171,569
Hides of cattle	16,113,639	18,315,739	16,001,902	16,871,656
All other	13,981,071	14,264,157	14,297,816	16,689,172
Hide cuttings, and other glue stock	1,068,273	1,186,627	826,206	786,396
Leather	5,750,937	6,196,687	5,507,377	5,051,361
Leather manufactures:				
Gloves	5,544,871	6,433,941	5,060,224	5,135,590
All other	598,507	667,168	808,338	1,024,819
Meat products	505,552	452,669	474,232	1,513,705
Dairy products:				
Butter	5,167	14,135	28,759	95,571
Cheese	1,710,855	1,948,033	2,335,829	2,862,677
Milk	50,286	47,996	36,897	24,459
Sausage casings	622,544	738,529	583,495	918,031
Wool, etc.:				
Raw	11,659,644	19,210,062	14,017,432	19,590,227
Manufactures	14,597,128	15,806,112	15,604,532	18,771,774
Total	106,309,089	116,109,443	113,186,057	127,909,553

IMPORTS AND EXPORTS OF FARM ANIMALS.

The short supply, with the consequent rise in prices, of all meat products in the United States during the greater part of 1902 naturally had a very depressing effect upon the foreign trade in farm animals for that year, and a glance at the export figures in the accompanying table will amply verify this, since they show an unvarying diminution all along the line.

Cattle.—Our imports of cattle last year footed up to 93,481 head. Of this number, 2,119 were high-class stock procured for breeding purposes, and the remainder, 91,362, a cheap grade of animals—"feeders"—brought in over the Mexican and Canadian borders to be fattened for market. These animals averaged in value about $13 per head last year; the average value in 1901 was $12. The average value of the breeding stock imported last year depreciated considerably from the figures of the year before; the 2,119 breeding cattle brought in last year averaged $165.50 per head, while the 1,424 imported in 1901 averaged as high as $221.50.

The exports fell from 454,590 to 327,118, a drop of no less than 127,472 head. It is somewhat singular, however, that the average price per head obtained last year was $6 less than in 1901, the respective averages being $80.50 for the exports of 1901 and $74.33 for those of 1902. But this does not necessarily mean that the animals were cheaper pound for pound; on the contrary, the known fact was that the average price per pound was about 2 cents higher last year than in 1901. It therefore follows that the export cattle of 1902 either averaged younger and smaller than those of 1901 or were sent out in less well-fed condition.

Hogs.—Imports of hogs (if any) are not shown separately in the returns, being included with "all other" animals.

The exports of hogs have been steadily decreasing for several years, and the scarcity of last year almost wiped the trade out entirely. Only 4,582 were sent abroad in 1902, as against 15,909 in 1901, 33,915 in 1900, and 52,230 in 1899—the high-water mark.

Horses.—The majority of the horses imported last year were for breeding purposes; 825 of this class came from British North America, 710 from the United Kingdom, and the remainder—1,759—from countries not enumerated. If the average price per head paid for this breeding stock may be taken as a criterion, it may be assumed that the imports of last year were of higher class than those of 1901, the price in 1902 amounting to $437.75 per head, while that of 1901 was $395.50 per head. The rest of the imports, consisting of 1,954 working horses, almost all came over the Canadian border; the average price of these was $155.50; the average value of the 1,950 working animals imported in 1901 was $152.25.

The number of horses exported last year was 60,694, which is less by 39,115 than the total sent abroad in 1901; nevertheless, when the reason for the large exports of 1900 and 1901 is considered, namely, the demand for war purposes in South Africa, which demand ceased to exist in 1902, and if then the above figures of last year are compared with those of the other years on the list it will be seen that they are remarkably large.

Mules.—There are no imports of mules in the returns, and the above remarks in regard to horses will explain the decrease in the exports,

the extraordinarily large shipments of the past three years being due to the same conditions.

Sheep.—Imports of sheep increased somewhat in 1902, the number entering being 304,755, which included 2,026 breeding animals. The total for 1901 was 265,952, of which 2,165 were breeding stock. The average values per head of the latter were a little less last year than the year before, the figures being $23 for 1901 and $21.25 for 1902. The same was also the case with the market animals, except that the difference was very slight, the average cost per head being for 1901 $3.50 and for 1902 $3.33.

Exports of sheep last year were no exception to the rule of decreases. The falling off, when compared with 1901, was, in fact, greater proportionally than that of cattle; but the shipments were nevertheless greater than those of two years ago, and were also in excess of most of the other years in the table.

The appended table gives the numbers and values of the imports and exports of farm animals annually from 1896 to 1902:

Number and value of imports and exports of farm animals for the years 1896 to 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Year.	Cattle.		Hogs.		Horses.		Mules.		Sheep.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
EXPORTS.		*Dollars.*		*Dolls.*		*Dollars.*		*Dollars.*		*Dollars.*
1896	394,772	36,576,412	33,785	367,917	28,632	3,601,137	6,534	475,106	323,576	1,948,841
1897	447,469	39,379,532	16,841	150,814	45,642	5,617,265	7,753	631,904	218,427	1,331,712
1898	397,879	33,463,267	16,879	117,546	48,917	6,010,773	6,996	514,569	176,498	1,070,966
1899	409,176	30,685,461	52,230	363,609	49,983	5,747,468	20,228	1,702,099	150,824	861,337
1900	423,181	33,819,164	33,915	313,836	79,520	9,102,432	50,179	4,757,892	148,391	900,734
1901	454,590	36,606,204	15,909	169,097	99,809	10,037,204	25,053	2,267,262	432,419	2,514,766
1902	327,118	24,301,969	4,582	47,186	60,694	6,086,012	16,306	1,744,192	235,497	1,492,484
IMPORTS.										
1896	141,653	988,677			8,252	509,819			382,443	1,013,481
1897	403,717	3,581,643			5,993	505,838			414,455	1,145,922
1898	261,826	2,730,882			2,718	321,835			360,820	1,187,210
1899	186,596	2,235,383			3,215	581,928			361,731	1,305,063
1900	142,055	1,871,546			3,541	886,811			345,985	1,260,132
1901	135,694	1,942,605			4,402	1,266,709			265,952	990,299
1902	93,481	1,569,313			5,248	1,745,868			304,755	1,049,231

The next table presents in greater detail the exports of farm animals for 1902, showing the numbers and values of the several kinds sent to each foreign country wherever such information is given in the returns.

Exports of cattle.—A large majority of our exports of cattle last year went, as usual, to the United Kingdom, the proportion having been 229,681 head out of a total of 327,118. This number, however, represents a great falling off when compared with the business of 1901, in which year the United Kingdom received 361,107 head; so the decrease

last year was 131,426 head, a fact which bears strong testimony to the short beef supply of that year. In addition to our large trans-Atlantic cattle trade, we also send considerable quantities to the West Indies (including Bermuda), and it was a remarkable fact that the number sent to this destination last year showed an increase over 1901. The number sent there in the last-named year was 71,583, while the shipments of 1902, as shown below, totaled 73,030 head. There was an increase also of 100 per cent in the number sent to Mexico, but our export trade in cattle with that country is not of great extent.

Exports of hogs.—Our exports of hogs are practically all taken by the neighboring countries of Canada, Mexico, and the West Indies, the latter being the chief consumer. The great falling off in this industry last year is exemplified by the shipments to the last-named islands, which amounted to only 2,095, as against 9,996 in 1901. There was, however, virtually no difference in the average price per head received for our shipments in the two years in question, the figures having been $10.67 for 1901 and $10.70 for 1902; but, inasmuch as pork was greatly enhanced in value in the latter year, this simply means—as was the case with cattle, previously explained—that the hogs exported in 1902 averaged considerably less heavy than those of the year before.

Exports of horses.—The special features of our export trade in horses last year were the heavy decreases in the shipments to British Africa and the United Kingdom and the increase in the trade with British North America. The former came about owing to the cessation of the Boer war, which caused the number sent to South Africa to decrease from 59,096 to 25,955, while the shipments to the United Kingdom fell from 18,377 to 6,455. On the other hand, the advance in the Canadian trade was quite remarkable, 21,823 animals going over the border last year, as against 14,323 in 1901. There was practically no change in values. The average price per head of all horses exported in 1902 was $100.25; that of 1901 was $100.50.

Exports of sheep.—The shortage in the domestic supply of farm animals in 1902 was also manifested in the exports of sheep, the total of which fell from 432,419, valued at $2,514,766, in 1901, to 235,497, valued at $1,492,484, in 1902. The two chief points of destination for our shipments are the United Kingdom and British North America, but the falling off last year was proportionally much greater in the latter than in the former. The United Kingdom received 262,222 in 1901 and 175,726 in 1902, while the exports to British North America decreased from 162,002 in 1901 to 51,538 last year. The latter number is, however, in excess of the business of 1900, and the same remark applies to the exports to the United Kingdom, so the retrograde movement was not as serious as was the case with the other farm animals. There was an increase in the average value per head received last year, the amount being $6.34, whereas the shipments of 1901 only averaged $5.82 per head.

Number and value of exports of farm animals for the calendar year 1902 and countries to which exported.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Country to which exported.	Number.	Value.
Cattle:		
United Kingdom	229,681	$21,943,345
Belgium	1,086	108,600
Other Europe	50	2,250
British North America	15,392	413,906
Central American States and British Honduras	51	3,825
Mexico	6,210	255,582
West Indies and Bermuda	73,030	1,495,423
South America	911	54,920
Asia and Oceania	11	1,800
Other countries	696	22,318
Total	327,118	24,301,969
Hogs:		
British North America	1,042	9,156
Mexico	1,395	14,977
West Indies and Bermuda	2,095	22,415
South America	20	391
Other countries	30	247
Total	4,582	47,186
Horses:		
United Kingdom	6,455	1,127,059
Belgium	248	35,911
Germany	137	16,475
Other Europe	1	50
British North America	21,823	1,867,478
Central American States and British Honduras	14	4,110
Mexico	1,983	106,241
West Indies and Bermuda	3,983	177,387
South America	12	2,145
Asia and Oceania	33	16,800
British Africa	25,955	2,727,365
Other Africa	50	5,000
Total	60,694	6,086,012
Mules	16,306	1,744,192
Sheep:		
United Kingdom	175,726	1,248,365
Other Europe	198	1,980
British North America	51,538	170,371
Mexico	1,969	11,190
West Indies and Bermuda	4,783	33,006
South America	1,006	8,732
Other countries	277	18,840
Total	235,497	1,492,484
All other, including fowls		167,450
Total animals		33,839,293

EXPORTS TO THE UNITED KINGDOM.

The annual increases which for several years past have been the feature of our trade in animals and animal products with the United Kingdom received a check in 1902. This, however, was to be expected, and is in keeping with the falling off in the total exports previously spoken of. The deficiency is accounted for in the same manner also, namely, because of the scarcity and high prices of meat products in the home market. The total values of our exports of animals and animal products to the United Kingdom for the past five years were as follows:

1898	$149,039,783
1899	155,555,299
1900	163,821,666
1901	181,397,723
1902	151,611,753

The deficiency as between last year and 1901 was no less than $29,785,970, but, large as this sum is, it will be found that the shrinkage in three items only of the meat products more than offsets it. These items were: Live cattle, which dropped in number from 361,107 to 229,681 and in value from $34,040,140 to $21,943,345; fresh beef, which fell in value from $31,899,293 to $24,692,148, and bacon, which decreased from $32,473,650 to $22,079,353. In view of the heavy deficits in these meat products it is significant that hams actually increased, going from $22,251,238 in 1901 to $23,362,282 in 1902; but although the value in the latter year was greater the quantity was less, owing to the higher prices prevailing. As instances of the latter it may be mentioned that the average price per pound of our fresh beef imported into the United Kingdom rose from 9.10 cents in 1901 to 10.34 cents in 1902; bacon rose from 9.47 cents to 10.90 cents per pound, and hams advanced from 10.57 cents to 11.33 cents per pound.

Of the other meat products we find a gain in canned beef and in lard. The manner in which the world's trade in the latter product is dominated by the American article may be judged by a perusal of our exports of lard to the United Kingdom for the three years last past, which were as follows:

Year.	Pounds.	Value.	Average price per pound.
			Cents.
1900	205,491,297	$14,244,979	6.93
1901	212,448,743	18,267,569	8.57
1902	198,718,040	20,419,131	10.28

It will be seen that although the quantity last year was less than that sent over in 1901 the value received for it was considerably greater, and that the average price per pound rose to the extent of over 3.25 cents in two years.

The leather and boot and shoe trade held its own, there being an increase in each item, although not in any instance a large one.

The butter trade suffered a serious relapse. Not only did the figures fail to come within striking distance of the high record of 1901, but they were even much below those of 1900, which in turn were very much smaller than those of 1899. It seems a necessity to remove the causes of this instability before the trade can assume permanently large proportions. There was a considerable decline in cheese also.

Following is a table giving in detail and in comparative form our exports of animal products to the United Kingdom for the years 1901 and 1902:

Quantity and value of animals and animal products purchased by the United Kingdom from the United States in the calendar years 1901 and 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article.	1901.		1902.	
	Quantity.	Value.	Quantity.	Value.
	Number.	*Dollars.*	*Number.*	*Dollars.*
Cattle	361,107	34,040,140	229,681	21,943,345
Horses	18,377	2,711,195	6,455	1,127,050
Sheep	262,222	1,984,868	175,726	1,248,365
	Pounds.		*Pounds.*	
Hides and skins (other than furs)	170,823	17,331	342,405	36,212
Sole leather	31,528,017	5,545,181	32,491,403	5,716,988
Other leather	....	9,812,092	....	10,467,906
Boots and shoes	....	1,847,187	....	2,088,315
Beef, canned	40,675,302	3,986,155	57,093,654	5,803,272
Beef, fresh	350,624,203	31,899,293	238,807,914	24,692,148
Beef, all other	18,112,375	1,110,603	16,919,961	1,305,779
Tallow	20,234,636	1,015,143	5,252,576	315,475
Bacon	363,736,542	32,473,650	218,785,008	22,079,353
Hams	206,318,614	22,251,238	199,744,745	23,362,282
Pork, fresh and salt	96,455,139	7,969,423	80,075,544	7,667,471
Lard	212,448,743	18,207,569	198,718,040	20,419,131
Oleo oil and oleomargarine	8,535,927	739,313	6,808,949	667,956
Butter	17,146,985	3,046,395	4,424,932	837,382
Cheese	29,179,866	2,740,947	16,990,776	1,833,323
Total	....	181,397,723	....	151,611,753

IMPORTS OF ANIMAL PRODUCTS INTO THE UNITED KINGDOM.

Below are presented tables giving information as to the total quantities and values of animals and animal products imported into the United Kingdom from all sources.

First is given the total quantity of meat of all kinds, including live cattle and sheep, bacon, hams, etc., annually received in British ports since 1890, together with the value (in pounds sterling) of the total animal food. The dead weight of the live animals is arrived at by reckoning 90 stone, of 8 pounds (or 720 pounds), per head for cattle, 16 stone (or 128 pounds) for calves, and 7½ stone (or 60 pounds) for sheep. The figures for 1902 serve as a good illustration of the effect of the shortage in this country upon the total receipts for that year, and in this connection it may be said that, roughly speaking, one-half of the said total was supplied by the United States. However, it is a

noticeable fact that notwithstanding the large diminution in the quantity for 1902 the value was greater than ever before.

The first table is as follows:

[From the London (England) Live Stock Journal.]

Year.	Dead weight of live meat.	Dead meat.	Total meat.	Total value of animal food.
	Cwt.[a]	*Cwt.*[a]	*Cwt.*[a]	£.
1890	4,039,000	10,068,239	14,107,239	57,362,959
1891	3,239,472	9,893,895	13,133,367	55,958,143
1892	3,269,998	10,607,672	13,877,670	60,347,530
1893	2,221,569	9,408,487	11,630,056	58,526,584
1894	3,315,310	10,718,870	14,034,180	61,895,186
1895	3,240,771	12,097,716	15,338,487	62,847,577
1896	4,027,613	13,518,095	17,545,708	66,263,079
1897	4,301,070	15,005,176	19,306,246	71,516,089
1898	4,012,898	16,445,295	20,458,193	73,100,786
1899	3,560,883	17,158,490	21,219,373	77,770,921
1900	3,386,861	17,911,738	21,298,599	83,951,999
1901	3,390,153	18,764,431	22,154,584	89,764,960
1902	2,852,453	16,970,558	19,823,011	89,880,755

[a] Of 112 pounds.

Next is presented (for comparison with our table of exports, on page 497) a detailed list of the imports from all sources into the United Kingdom of animals and animal products in 1902.

Quantities and values of animals and animal products imported by the United Kingdom during the calendar year 1902.

[Compiled from Trade and Navigation, published by the British Government.]

Article.	Quantity.	Value.
Cattle ... number	419,488	$38,030,435
Sheep ... do	293,199	2,211,445
Horses ... do	32,686	4,067,114
Rabbits (dead) ... cwts.[a]	451,457	3,573,598
Poultry and game	------------	5,153,916
Bacon ... cwts.[a]	5,039,704	62,242,335
Hams ... do	1,482,287	18,779,833
Beef:		
Fresh ... do	3,707,387	38,470,383
Salted ... do	153,574	1,187,436
Pork:		
Fresh ... do	655,376	7,035,665
Salted ... do	205,265	1,487,139
Mutton, fresh ... do	3,659,599	33,651,414
Meat, all other ... do	1,565,909	19,391,392
Lard ... do	1,650,830	20,045,035
Tallow and stearin ... do	1,782,098	13,181,825
Butter ... do	3,974,177	99,899,191
Cheese ... do	2,546,384	31,206,042
Milk, condensed ... do	914,087	8,774,475
Margarin ... do	966,170	12,504,243
Eggs ... gt. hunds.[b]	18,930,513	30,658,629
Glue ... cwts.[a]	234,575	2,329,506

[a] Of 112 pounds. [b] A great hundred is 120.

Quantities and values of animals and animal products imported by the United Kingdom during the calendar year 1902—Continued.

Article.	Quantity.	Value.
Bristles ... pounds	4,583,100	$3,049,247
Hides, raw ... cwts.[a]	947,722	11,878,328
Goatskins, undressed ... number	16,512,508	7,446,290
Sheepskins, undressed ... do	16,301,695	7,840,253
Leather ... cwts.[a]	1,198,963	39,402,284
Boots and shoes ... pairs	2,924,422	4,276,749
Leather gloves ... do	20,976,432	8,368,404
Hair, camel's, etc ... pounds	7,345,028	820,409
Mohair ... do	30,028,508	8,976,707
Wool, raw ... do	643,670,277	98,537,666
Wool manufactures		66,401,699
Total		710,880,177

[a] Of 112 pounds.

It will be seen that the United Kingdom has to foot a very large bill annually for animal products. The dependence of the British in this respect upon outside sources of supply may well be illustrated by comparing the above total with the corresponding one for the United States, given on page 000. Although our population is very much larger than that of the United Kingdom, the total value of the products of animal origin imported by us in 1902 was less than one-fifth of the total for that country.

Of the items enumerated on the above list the following were supplied largely—in some cases almost wholly—by the United States: Live cattle and sheep, beef and pork products, hams, and lard.

There is an apparent discrepancy in the figures for hams, inasmuch as the quantity sent by us to the United Kingdom in 1902 was 199,744,745 pounds, valued at $23,362,282 (United States official figures), whereas the quantity received by the United Kingdom from us was 147,031,248 pounds, valued at $16,653,182 (from British official figures). There seems to be no explanation for this contradiction, because it can not be accounted for by the hams being reexported on the other side, as the returns do not show any; nor were they reexported as British produce, as the returns are blank in this respect also, and, lastly, they could not have gone through Canada and been credited to that country, because the total receipts from the Dominion did not amount to one-third of the discrepancy.

In contrast with the practical monopoly which we have in hams and lard, and to a less extent in beef, it will be noticed that the proportion of bacon we furnish is considerably smaller. But here is another contradiction of official figures, although this time we are credited on the other side with more than we sent. Our export figures for bacon in 1902 were 218,785,008 pounds, valued at $22,079,353, while the British imports are given as 367,791,760 pounds, valued at $40,097,634. Be that as it may, however, it is an undisputed fact that we have a

strong competitor in the bacon trade in Denmark, more especially because of the superior quality of the article raised in that country, and it would seem to be a profitable undertaking for our bacon growers to ascertain the causes by which the Danish exporters have for a number of years been getting about 4 cents a pound more for their bacon in the English market than the American product brings.

We supplied rather less than one-half the leather and boots and shoes, about one-fourth of the horses, a very small proportion only of butter, cheese, oleomargarine, and tallow, and practically none of the following: Fresh mutton, rabbits, condensed milk, eggs, poultry and game, and hides and skins, to say nothing of hair and wool products, which latter are not extensively raised in this country.

The list shows that the United Kingdom imports a number of the items named in the preceding paragraph in considerable quantities. It therefore follows that, large as is our export trade with that country in animal products, there is yet room for a much greater expansion.

EXPORTS TO GERMANY.

The total value of our exports of animal products to Germany last year was $21,955,429 and that of the previous year $23,143,539, showing a falling off in 1902 of $1,188,110. This is quite a good showing when considered in connection with the scarcity of meat products which prevailed and the large decreases in the shipments to other countries.

The principal animal product exported by the United States to Germany is lard, more than two-thirds of the entire total being taken up by it. There was a decrease of 35,979,214 pounds in the quantity of lard sent over last year as compared with the year before, the totals having been 186,136,934 pounds in 1901 and 150,157,720 pounds last year, but the difference in the respective values was relatively not nearly so great, indicating a rise in prices. The total valuation for 1901 was $15,861,432, and that of last year $15,088,075, a decrease of $773,357 only. The respective unit prices were 8.52 cents per pound for 1901 and 10 cents for last year, or a rise of practically 1.50 cents per pound.

The oleo products—oleo oil and oleomargarine—are next in importance of the exports, and these fell off slightly also, as did tallow and all the pork products; but the two beef items actually increased—more especially "other beef," composed of the salted, pickled, and other cured varieties, which totaled $646,317, as against $470,553 in 1901. Dairy products fell away to almost nothing, and horses decreased very considerably as well; but there was a material increase in hides and skins, and the same remark applies to the three items of leather and manufactures, showing the leather and boot and shoe trades to be in a flourishing condition.

Appended is a comparative statement of our exports of animal products to Germany for the calendar years 1901 and 1902.

Quantity and value of animals and animal products purchased by Germany from the United States in 1901 and 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article.	1901.		1902.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
Horses........number..	553	86,900	137	16,475
Hides and skins (other than furs)........	4,435,960	333,660	5,565,901	417,124
Sole leather........	38,865	7,307	76,470	15,317
Other leather........	....	676,901	....	774,246
Boots and shoes........	....	201,599	....	267,766
Canned beef........	400,887	38,360	529,883	52,738
Other beef........	7,642,475	470,553	8,987,524	646,317
Tallow........	6,232,070	337,088	3,278,429	213,797
Bacon........	19,031,622	1,492,586	16,106,995	1,455,434
Hams........	2,409,370	254,646	1,389,295	139,792
Pork........	8,488,825	650,400	5,793,297	498,230
Lard........	186,136,934	15,861,432	150,157,720	15,088,075
Oleo and oleomargarine........	32,760,779	2,645,105	24,052,520	2,368,574
Butter........	552,714	86,462	7,837	1,138
Cheese........	5,295	540	4,160	406
Total........	....	23,143,539	....	21,955,429

IMPORTS OF ANIMAL PRODUCTS INTO GERMANY.

Below is given a list of the animals and animal products imported into Germany (from all sources) during the calendar year 1902, together with their total values in United States money, the latter having been converted from the official figures, which are given in marks. The grand total amounts to $307,929,874, which sum, although less than half the similar total for the United Kingdom (see p. 499) nevertheless appears very large when compared with those of France and the United States (shown, respectively, on pp. 504 and 491), since it is greater than both of them combined.

In comparing the German imports, as shown on the list below, with the preceding statement of our exports to that country, which shows what share was furnished by us, it will be seen that our contribution to most of the items is very small; we do supply considerable proportions of the bacon and oleomargarine, but the only item which we in any sense monopolize is lard; there is therefore much room for improvement in our trade relations with the German Empire.

It is to be feared, however, that the outlook in this direction is but gloomy on account of the new tariff laws recently enacted by the German Government, which are expected to go into effect in the early part of 1904. The increased rates imposed by this legislation are certain to have a detrimental effect on our trade. We shall no doubt continue to supply the German people with large quantities of lard, because the duty on this product has been raised but slightly, but prohibitive rates have been placed on nearly all the other animal products, as, for instance, cured meats, the duty on which has been raised from

$4.04 to $10.71 per 100 kilograms, or 220.4 pounds avoirdupois; margarine, which goes from $3.80 to $7.14 per 100 kilograms, and horses, which now pay $4.76 per head, will be taxed anywhere from $21.42 to $85.68 per head, according to class; the above increased rates may, however, be subject to some revision by treaty.

The list of animals and animal products imported into Germany in 1902 is as follows:

Value of animals and animal products imported into Germany during the calendar year 1902.

[Compiled from "Auswärtiger Handel des Deutschen Zollgebiets," published by the German Government.]

Article.	Value.	Article.	Value.
Hide cuttings	$755,412	Eggs	$27,419,980
Bones, horns, etc., and manufactures	1,876,392	Sausage casings, etc	10,898,734
Glue	419,356	Horses:	
Albumin	361,760	Working, light	5,427,352
Bone ash, bone meal, etc	852,754	Working, heavy	13,553,862
Feathers:		For breeding	335,342
Crude	4,164,048	For pleasure	1,886,388
Prepared	658,784	Ponies, etc	74,970
For quills	9,758	Foals	19,472
Bristles	4,982,292	Mules, etc	29,750
Hides of cattle	19,727,344	Cows	8,553,482
Calfskins	9,416,232	Steers	808,724
Horse hides	2,418,794	Oxen	7,288,988
Sheepskins	97,104	"Young cattle"	4,753,336
Goatskins	56,168	Calves (under 6 weeks)	343,910
All other hides and skins (not furs)	1,340,416	Hogs	1,696,940
Leather	7,607,194	Sucking pigs	8,806
Boots and shoes	2,055,368	Sheep	35,462
Harness and saddles	205,632	Lambs	238
Gloves	2,023,238	Goats	14,994
All other leather manufactures	1,233,792	Live poultry	8,693,664
Beef, fresh	2,798,166	All other live animals	309,356
Pork, fresh	4,914,700	Horsehair	1,258,544
All other fresh meats	44,030	Prepared	130,186
Beef, salted, etc	733,754	Woven	66,640
Pork, salted, etc	1,535,814	Hair of alpaca, camel, etc	344,862
Hams	822,528	Other animal hair	1,189,286
Bacon	2,156,756	Hair manufactures	44,982
Sausage	38,318	Plushes	24,038
All other cured meats	17,850	Wool:	
Canned meats	10,234	Raw	46,559,702
Meat extracts	2,494,478	Scoured	15,208,202
Poultry and game	2,559,452	Combed or carded	16,973,922
Lard	16,643,816	Other	2,349,774
Tallow	3,722,820	Wool yarns	13,383,454
Other animal fats	570,010	Mohair and alpaca yarns	7,675,738
Butter, fresh	6,076,140	Wool manufactures	10,234
"Melted butter"	317,016	All other animal products	39,032
Oleomargarine	4,388,244	Total	307,929,874
Milk:			
Fresh	433,160		
Condensed	1,904		

EXPORTS TO FRANCE.

Our shipments of animal products to France continued on the down grade in 1902; they indeed dwindled almost to the vanishing point. It will be seen from the table below that the trade of 1901, small as it was, was yet double that of last year, the latter only totaling the insignificant sum of $1,129,257.

It was to be expected there would be a large falling off in the exports of meat products because of the scarcity at home, and this would account for the serious drop in the lard, tallow, and bacon totals. In comparing the business of last year with that of 1901, we find that lard decreased from $974,374 to $288,256, tallow fell from $290,459 to $95,834, and bacon from $155,969 to $27,236. There was a slight shrinkage even in leather and boots and shoes, in fact the decline affected every article on the list, without exception.

A comparative statement of the exports of 1901 and 1902 follows:

Quantity and value of animals and animal products purchased by France from the United States during the calendar years of 1901 and 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article.	1901.		1902.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
Hides and skins (other than furs)	178,007	20,964	125,279	14,145
Leather		547,064		507,493
Boots and shoes		121,573		110,391
Canned beef	674,588	67,448	592,000	60,015
Other beef	148,890	7,697	101,000	6,590
Tallow	5,560,246	290,459	1,535,842	95,834
Bacon	1,960,196	155,969	282,884	27,236
Hams	320,856	31,454	138,592	14,676
Pork	91,800	7,295	46,000	4,621
Lard	12,060,253	974,374	3,035,846	288,256
Total		2,224,297		1,129,257

IMPORTS OF ANIMAL PRODUCTS INTO FRANCE.

Appended is a statement giving the value of the imports into France, from all sources, of animals and animal products during the year 1901. It is compiled from the official publication of the French Government and sets forth in the first column the entire receipts, and in the second the amount consumed in France, the difference between the two being the portion in transit destined for points outside of the country. The figures for 1902 are not available at this writing, but it may be stated they are most likely very much the same, judging from the information contained in Consular Reports for March, 1903 (Vol. LXXI, No. 270), which states that the total value of food products imported into France in 1902 was $152,192,080 as against $151,299,262 in 1901, a very slight difference only.

It will be seen from the table that France is a considerable importer

of commodities of which, under normal conditions, we have a large surplus; so it would seem to be largely a question of overcoming prejudice, together with the establishment of more favorable transportation facilities, freights, etc., and the proper exploitation of our wares, in order to augment greatly our trade in animal products with the French Republic.

Value of animals and animal products imported into France during the calendar year 1901.

[Compiled from "Tableau Général du commerce et de la navigation," published by the French Government.]

Article.	Total imports.	Consumed in France.
Live animals:		
Horses	$2,719,881	$2,613,442
Mules and asses	296,859	278,090
Cattle	1,914,108	1,698,435
Sheep	5,380,039	5,301,799
Goats	4,668	4,441
Hogs	289,179	92,245
Poultry and game	627,222	371,792
All other	1,663,706	1,520,944
Meat products:		
Beef—		
Fresh	466,908	410,955
Salt	131,893	31,359
Pork—		
Fresh	224,314	224,308
Salt	1,765,512	1,427,567
Sausages	1,012,307	898,985
Poultry and game	1,696,964	1,402,587
Canned meats	372,245	111,819
Tallow	2,162,009	2,009,376
Lard	1,771,795	1,509,174
Oleomargarine	51,869	31,335
Other animal fats	718,495	691,934
Eggs	5,413,749	3,570,525
Eggs, yolks (not for food)	230,952	230,292
Dairy products:		
Butter—		
Fresh	4,646,077	3,625,553
Salt	87,803	23,379
Cheese—		
Swiss	7,333,454	6,020,666
Other	1,262,701	638,132
Milk—		
Fresh	12,346	12,362
Condensed	189,788	25,578
Hides and skins (other than furs)	30,373,047	26,218,212
Wool	77,803,663	73,836,020
Hair	1,555,141	1,234,919
Bristles	896,910	834,333
Feathers	7,193,167	7,137,736
Feathers for quill pens	14,877	14,870
Bone, boneblack, etc	1,025,415	1,015,748
All other animal products	6,634,979	5,442,564
Total	167,935,355	150,511,486

EXPORTS OF MEAT AND DAIRY PRODUCTS.

The tabular statement next following shows our annual exports of meat and dairy products, by articles, from 1896 to 1902, inclusive.

Beef products.—There was a decrease in round figures of $5,000,000 in the total value of these exports last year as compared with 1901. Of the four products which come under this heading it will be seen from the table that fresh beef sustained the heaviest loss in total value, although, proportionately, the falling off in tallow was much greater. On the other hand, an increase may be noted in the two remaining products, namely, canned beef and salted or cured beef, and this was quite considerable in the first named.

The exports of fresh beef last year amounted to 242,015,093 pounds, while those of 1901 reached the large total of 354,421,731 pounds, these figures being, respectively, the lowest and the highest on the list. But owing to the rise in prices last year the decrease in the total value was not nearly so great as that in the quantity, and it may here be stated that the average price per pound obtained for our exports of fresh beef last year was 10.34 cents, while that of 1901 was 9.11 cents.

The canned beef sent abroad last year aggregated 81,362,981 pounds, which is an increase of 28,123,399 pounds over 1901. The increase in the total value was even greater, proportionately, than in the quantity, the total of 1902 having been $8,384,454, or an advance of $3,150,672 on the figures of the previous year. Expressed in another way, this is an increase of 60 per cent. The average price per pound of the exports of 1901 was 9.83 cents; last year the price obtained was 10.31 cents.

There was a satisfactory increase also in the total valuation of salted, pickled, or other cured beef for last year, although the quantity shipped abroad was less by several thousand pounds than that of 1901—an evidence of enhanced values. The total valuation for 1902 was $3,375,401, as against $3,099,492 for 1901, or an increase of $275,909. The average value per pound for 1901 was 5.90 cents; last year it had risen to 7.15 cents.

Tallow decreased in quantity from 51,846,765 pounds to the comparatively small total of 21,365,465 pounds, which represented last year's export business. The total value fell from $2,698,692 to $1,330,604, but there was an advance of fully 1 cent in the average value per pound, the figures being 5.21 cents for 1901 and 6.23 cents for 1902.

Hog products.—The majority of these products show a considerable decline in the exports of 1902 as compared with those of 1901. There were, however, two exceptions, of which canned pork alone showed an increase in both quantity and value, while hams, although less in quantity, gained in total valuation.

The scarcity of the home supply caused an enormous depreciation

in the quantity of bacon exported last year, the total being 270,141,141 pounds, as against 447,620,337 for 1901; but the decrease in the total value was relatively much less, the amounts being $39,402,500 for 1901 and $27,101,431 for 1902. The average price per pound was therefore necessarily higher last year; it rose, in fact, very close to 1.25 cents for each pound exported. The exact averages for the years in question were 8.80 cents for 1901 and 10.03 cents for 1902.

The quantity of hams shipped abroad last year was not quite so large as that of the year before, when 230,456,004 pounds were sent out, the quantity last year being 224,982,389 pounds; but the total valuation was higher—the highest on the list, in fact—the amount reaching $26,151,091, while that of 1901—the next highest—was $24,739,003. The rise in the price of hams was not, however, quite as great as that of bacon, mentioned in the preceding paragraph, it being a little under 1 cent per pound; the exact averages for the exports of hams for the past two years were 10.73 cents per pound for 1901 and 11.62 cents for last year.

Both salted and fresh pork showed a diminished export business in 1902, but the falling off was not large in either case, and values continued on the rise.

Canned pork, like canned beef, made a considerable advance in both quantity and value. The total shipments last year amounted to 13,044,954 pounds, valued at $1,240,331; while the totals of 1901 were 9,341,262 pounds, with a valuation of $744,455; thus showing an increase in 1902 of 3,703,692 pounds in quantity and $495,876 in value. The rise in unit value was also no less marked than that of the totals, the average value per pound advancing from 7.97 cents in 1901 to 9.51 cents last year.

Lard is by far the largest single item in our exports of animals and animal products. The export list on page 490 shows its proportion to the whole to be 20 per cent, while bacon, hams, fresh beef, and cattle come next in order of magnitude, all the latter being close together in this respect and each having approximately 10 per cent of the total; the five products named thus consuming 60 per cent of the entire exports.

There was a falling off of about one-sixth in the quantity of lard shipped out of the country last year when compared with 1901. The business of the latter year amounted to 607,266,176 pounds, valued at $51,626,346, while last year's shipments totaled 504,153,355 pounds, with a valuation of $50,869,699. It may be seen from the table below that the totals of 1902, just mentioned, when taken together, stand in a somewhat extraordinary relation to the other lard totals, inasmuch as the quantity for 1902 is the smallest of the series, whereas the valuation comes out second—is very close to the first, in fact. This must mean that there has been a very considerable increase in the market value of this product. It may therefore be of interest to look into

the extent of this rise by taking the averages of several of the years on the list. In 1896, the first year mentioned, the average price per pound obtained for our exports was only 5.67 cents. Three years later (in 1899) we find the value but a trifle higher, namely, 6.02 cents, and although there was a noticeable increase in 1900, it was still under 7 cents. The greatest advances took place in the last two years, each of which saw a rise of fully 1.50 cents per pound, the average for 1901 having been 8.50 cents and for last year 10.09 cents. It will thus be seen there has been the unprecedented advance of more than 4 cents per pound in three years.

Miscellaneous meat products.—All of these show a smaller export business last year than in 1901, but in no case is the decrease very prominent.

The most important of these products is oleo oil and oleomargarine, and it should be mentioned here that our foreign trade is almost entirely with the oil. The finished product, oleomargarine, comprises only about 5 per cent of the total. The exports of the combined product last year were 114,482,615 pounds, valued at $11,124,850. Those of 1901 were somewhat larger, namely, 168,923,216 pounds, with a valuation of $13,451,234. A scrutiny of these figures will show that the falling off was more marked in the quantity than in the value. There was, indeed, a very distinct rise in the average price per pound last year. The following are some figures regarding export values of the oil by which it will be seen the rise in 1902 was extremely marked: The average price per pound in 1900 was 7.22 cents; in 1901 it was 7.91 cents, and last year it reached 9.66 cents.

Dairy products.—There was a serious falling off in the exports of butter in 1902, but it may be noted from the table below that these have been of an erratic nature for several years. The quantity sent abroad in 1901 was 24,249,565 pounds; last year it was only 8,959,316 pounds. There was, however, a rise in the value, the average price going from 17.26 cents per pound in 1901 to 18.77 cents in 1902, an increase of 1.50 cents.

Shipments of cheese decreased also, but to a much less extent than those of butter. The total quantity sent abroad last year was 19,095,438 pounds, as against 31,396,115 pounds in 1901. The price paid for our cheese rose to an even greater extent than that of butter, the average valuation per pound having been 11.05 cents last year, while the price received in 1901 averaged 9.57 cents.

Exports of milk depreciated about 40 per cent last year, the total valuation having been $1,090,051, as against $1,646,579 in 1901. The returns do not say how much of the product is fresh milk and how much the condensed variety, but the latter no doubt forms the larger proportion, although it has been demonstrated by the Bureau of Animal Industry that fresh milk can be exported to Europe in excellent condition.

The accompanying table shows the extent of each of the above exports annually for the past seven years:

Exports of meat and meat products and dairy products for the years 1896 to 1901.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article.	Quantity.	Value.
Beef, canned:	*Pounds.*	*Dollars.*
1896	61,168,927	5,335,283
1897	42,804,831	3,728,607
1898	37,866,632	3,448,240
1899	49,393,218	4,529,550
1900	51,915,745	5,150,013
1901	53,239,582	5,233,782
1902	81,362,981	8,384,454
Beef, fresh:		
1896	282,925,463	22,498,251
1897	279,882,590	22,298,328
1898	267,458,906	22,644,040
1899	322,635,630	28,194,697
1900	326,356,576	29,307,778
1901	354,421,731	32,294,877
1902	242,015,093	25,028,304
Beef, other, cured:		
1896	85,893,296	4,707,094
1897	43,854,117	2,244,568
1898	48,724,793	2,737,304
1899	46,065,647	2,617,828
1900	56,351,147	3,277,680
1901	52,528,512	3,099,492
1902	47,198,997	3,375,401
Tallow:		
1896	85,449,086	3,336,111
1897	55,609,096	2,029,735
1898	106,819,190	4,209,395
1899	97,213,186	4,283,751
1900	92,555,436	4,674,801
1901	51,846,765	2,698,692
1902	21,365,465	1,330,604
Bacon:		
1896	436,859,660	31,057,506
1897	578,082,822	39,820,382
1898	619,683,235	45,786,045
1899	558,005,388	41,008,919
1900	469,924,828	37,099,980
1901	447,620,337	39,402,500
1902	270,141,141	27,101,431
Hams:		
1896	156,912,852	15,224,842
1897	171,956,663	16,581,659
1898	220,011,750	20,384,650
1899	216,646,559	21,015,536
1900	198,328,048	21,043,597
1901	230,456,004	24,739,093
1902	224,982,389	26,151,091
Pork, salted or pickled:	*Pounds.*	*Dollars.*
1896	63,544,168	3,204,986
1897	68,764,530	3,563,945
1898	116,865,578	6,804,048
1899	137,573,905	7,996,794
1900	140,915,057	9,380,615
1901	127,863,335	10,254,695
1902	98,262,179	9,404,635
Pork, fresh:		
1896	315,345	18,161
1897	4,185,059	289,237
1898	30,464,516	2,027,565
1899	34,041,243	2,334,826
1900	25,576,765	1,987,566
1901	40,348,780	3,224,726
1902	31,171,784	2,764,950
Pork, canned:		
1899 *a*	3,570,524	270,577
1900	9,368,005	744,197
1901	9,341,262	744,455
1902	13,044,954	1,240,331
Lard:		
1896	526,320,203	29,821,308
1897	630,060,611	32,622,409
1898	736,636,222	43,440,170
1899	690,068,669	41,531,142
1900	609,473,372	42,033,597
1901	607,266,176	51,626,346
1902	504,153,355	50,869,699
Oleo oil and oleomargarine:		
1896	120,686,267	8,255,849
1897	122,055,911	7,391,091
1898	142,272,339	8,654,721
1899	144,438,709	10,241,347
1900	164,321,706	11,985,976
1901	168,923,216	13,451,234
1902	114,482,615	11,124,850
Sausage and sausage meats:		
1900 *a*	5,867,982	543,804
1901	7,140,383	699,841
1902	6,328,527	672,770
Sausage casings:		
1896	....	1,686,930
1897	....	1,677,033

a Included in "All other meat products" previous to this date.

Exports of meat and meat products and dairy products, etc.—Continued.

Article.	Quantity.	Value.	Article.	Quantity.	Value.
Sausage casings—Continued.	*Pounds.*	*Dollars.*	Butter:	*Pounds.*	*Dollars.*
			1896	27,220,213	3,909,900
1898		1,762,431	1897	30,914,783	4,497,878
1899		1,899,164	1898	15,034,189	2,428,143
1900		2,931,603	1899	27,309,869	4,502,744
1901		2,022,496	1900	13,283,557	2,396,062
1902		1,755,293	1901	24,249,565	4,184,966
Meat products not specified:			1902	8,959,316	1,681,723
			Cheese:		
1896		2,413,281	1896	44,530,234	3,846,703
1897		3,243,188	1897	60,180,651	5,432,371
1898		5,190,547	1898	40,523,994	3,376,818
1899		5,810,955	1899	34,686,833	3,376,108
1900		5,015,000	1900	54,059,049	5,549,254
1901		5,672,446	1901	31,396,115	3,006,344
1902		4,487,623	1902	19,095,438	2,109,347
Poultry and game:			Milk:		
1896		51,981	1896		397,181
1897		66,316	1897		635,370
1898		91,819	1898		692,925
1899		236,322	1899		1,188,057
1900		679,440	1900		1,288,127
1901		866,322	1901		1,646,579
1902		847,430	1902		1,030,051

The next tabular statement presents the export business of the above products for 1902 in detail, as regards their distribution; the quantity and value sent to each country or other territorial division of the globe is given whenever such information is available.

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1902, by countries.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Article and country to which exported.	Quantity.	Value.
Beef, canned:	*Pounds.*	*Dollars.*
United Kingdom	57,093,654	5,803,272
Belgium	385,669	38,727
France	592,000	60,015
Germany	529,883	52,738
Italy	56,100	5,581
Netherlands	143,275	14,420
Other Europe	487,284	46,779
British North America	770,710	77,832
Central American States and British Honduras	263,961	25,654
Mexico	169,549	19,993
Cuba	49,112	4,169
Other West Indies and Bermuda	445,239	43,180
Argentina	1,096	123

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1902, by countries—Continued.

Article and country to which exported.	Quantity.	Value.
Beef, canned—Continued.	*Pounds.*	*Dollars.*
Brazil	80,303	9,453
Colombia	93,474	9,843
Other South America	248,372	25,484
Chinese Empire	56,795	7,527
British East Indies	68,426	7,390
Hongkong	201,267	21,278
Japan	28,175	3,560
British Australasia	156,475	14,897
Philippine Islands	717,921	78,445
Other Asia and Oceania	67,940	8,838
British Africa	15,032,180	1,638,627
All other Africa	3,606,493	361,612
Other countries	17,628	2,011
Total	81,362,981	8,384,454
Beef, fresh:		
United Kingdom	238,807,914	24,692,148
British North America	476,086	53,813
West Indies and Bermuda	2,703,166	279,953
Other countries	27,927	2,390
Total	242,015,093	25,028,304
Beef, other:		
United Kingdom	16,919,961	1,305,779
Belgium	1,530,610	99,877
France	101,000	6,590
Germany	8,987,524	646,317
Netherlands	956,915	70,224
Other Europe	2,320,706	137,081
British North America	5,501,849	361,378
Central American States and British Honduras	592,032	40,210
Mexico	7,753	570
Cuba	83,706	4,936
Other West Indies and Bermuda	4,322,564	305,325
Brazil	7,000	473
Chile	103,625	7,493
Colombia	256,250	17,467
Other South America	3,082,361	223,858
Asia and Oceania	1,481,848	89,386
British Africa	673,423	40,729
All other Africa	204,020	12,960
Other countries	65,850	4,748
Total	47,198,997	3,375,401
Tallow:		
United Kingdom	5,252,576	315,475
Belgium	842,555	48,149
France	1,535,842	95,834
Germany	3,278,429	213,797
Italy	22,514	1,508
Netherlands	3,432,871	193,602
Other Europe	1,938,632	124,651
British North America	76,505	4,373
Central American States and British Honduras	1,748,914	115,081

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1902, by countries—Continued.

Article and country to which exported.	Quantity.	Value.
Tallow—Continued.	*Pounds.*	*Dollars.*
Mexico	528,191	30,990
Cuba	128,625	7,276
Other West Indies and Bermuda	1,321,600	87,522
Brazil	329,387	26,905
Chile	37,139	3,020
Colombia	46,685	3,880
Other South America	635,642	43,586
Asia and Oceania	20,756	1,317
Other countries	158,602	13,638
Total	21,365,465	1,330,604
Bacon:		
United Kingdom	218,785,008	22,079,353
Belgium	13,857,054	1,362,357
France	282,884	27,236
Germany	16,106,995	1,455,434
Netherlands	5,591,831	548,681
Other Europe	4,625,869	453,500
British North America	3,966,932	434,319
Central American States and British Honduras	262,219	26,694
Mexico	264,363	32,754
Cuba	3,849,501	379,188
Other West Indies and Bermuda	318,568	41,522
Brazil	1,521,473	167,981
Colombia	28,217	2,971
Other South America	245,016	27,790
Chinese Empire	102,457	16,230
Philippine Islands	54,110	8,024
Other Asia and Oceania	155,639	25,633
British Africa	93,020	8,935
All other Africa	29,915	2,829
Total	270,141,141	27,101,431
Hams:		
United Kingdom	199,744,745	23,362,282
Belgium	5,495,983	567,245
France	138,592	14,676
Germany	1,389,295	139,792
Netherlands	1,963,324	205,283
Other Europe	1,498,266	165,430
British North America	5,864,870	663,099
Central American States and British Honduras	247,754	29,963
Mexico	487,807	61,932
Cuba	4,732,641	505,757
Other West Indies and Bermuda	1,724,425	210,023
Brazil	23,159	2,612
Colombia	134,387	15,444
Venezuela	223,382	31,154
Other South America	383,068	48,393
Chinese Empire	219,196	34,049
British Australasia	33,284	4,094
Philippine Islands	173,955	21,208
Other Asia and Oceania	230,016	33,819
British Africa	237,629	30,098

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1902, by countries—Continued.

Article and country to which exported.	Quantity.	Value.
Hams—Continued.	*Pounds.*	*Dollars.*
All other Africa	10,971	1,367
Other countries	25,640	3,371
Total	224,982,389	26,151,091
Pork, canned	13,044,954	1,240,331
Pork, fresh and salted:		
United Kingdom	80,075,544	7,667,471
Belgium	4,665,023	453,142
France	46,000	4,621
Germany	5,793,297	498,230
Netherlands	5,643,534	522,159
Other Europe	4,856,771	465,657
British North America	10,111,244	859,133
Central American States and British Honduras	1,334,511	118,799
Cuba	3,523,211	316,383
Other West Indies and Bermuda	8,557,902	803,049
Brazil	129,100	13,021
Colombia	156,092	14,133
Other South America	3,229,968	297,528
Philippine Islands	11,400	1,072
Other Asia and Oceania	609,301	57,755
British Africa	563,776	64,840
All other Africa	12,700	1,103
Other countries	114,589	11,489
Total	129,433,963	12,169,585
Lard:		
United Kingdom	198,718,040	20,419,131
Belgium	22,890,076	2,324,201
France	3,035,846	288,256
Germany	150,157,720	15,088,075
Italy	1,195,985	118,830
Netherlands	45,970,067	4,706,358
Other Europe	20,053,883	1,978,358
British North America	970,403	105,025
Central American States and British Honduras	1,974,839	195,746
Mexico	5,787,243	523,365
Cuba	25,290,465	2,197,928
Other West Indies and Bermuda	6,456,582	606,361
Argentina	46,297	5,040
Brazil	8,084,776	924,582
Chile	364,894	42,681
Colombia	1,222,178	109,952
Venezuela	2,749,658	298,388
Other South America	4,557,589	437,388
Philippine Islands	240,679	23,390
Other Asia and Oceania	819,922	86,764
British Africa	3,121,954	342,932
All other Africa	374,209	40,011
Other countries	70,050	6,937
Total	504,153,355	50,869,699
Lard compounds	36,862,459	2,889,476

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1902, by countries—Continued.

Article and country to which exported.	Quantity.	Value.
	Pounds.	*Dollars.*
Mutton	3,790,019	319,327
Oleo and oleomargarine:		
United Kingdom	6,808,949	667,956
Germany	24,052,520	2,368,574
Netherlands	55,512,062	5,431,874
Other Europe	23,491,124	2,164,649
British North America	1,091,382	112,699
Central American States and British Honduras	186,990	19,603
Mexico	99,260	12,946
West Indies and Bermuda	2,598,949	279,020
Colombia	116,038	10,906
Other South America	330,814	35,822
Asia and Oceania	60,417	6,326
Other countries	134,110	14,475
Total	114,482,615	11,124,850
Poultry and game		847,430
Sausage and sausage meats	6,328,527	672,770
Sausage casings		1,755,293
All other meat products:		
Canned		1,779,193
All other		2,708,430
Butter:		
United Kingdom	4,424,932	837,382
Germany	7,837	1,138
Other Europe	825	182
British North America	778,093	157,102
Central American States and British Honduras	189,247	40,919
Mexico	433,106	86,160
Cuba	122,917	26,624
Other West Indies and Bermuda	1,263,450	238,457
Brazil	816,867	116,410
Colombia	60,378	13,626
Venezuela	493,585	84,363
Other South America	115,082	22,115
Chinese Empire	41,927	9,724
Japan	154,854	34,347
Philippine Islands	6,623	1,193
Other Asia and Oceania	43,654	10,665
British Africa	2,190	610
All other Africa	295	85
Other countries	3,454	621
Total	8,959,316	1,681,723
Cheese:		
United Kingdom	16,990,776	1,833,323
Germany	4,160	406
British North America	126,924	16,307
Central American States and British Honduras	168,470	22,607
Mexico	390,487	50,288
Cuba	114,436	14,593
Other West Indies and Bermuda	717,224	91,256
Brazil	328	22

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1902, by countries—Continued.

Article and country to which exported.	Quantity.	Value.
Cheese—Continued.	*Pounds.*	*Dollars.*
Colombia	82,209	10,960
Other South America	16,101	2,230
Chinese Empire	206,397	28,471
Japan	59,408	8,089
Philippine Islands	11,339	1,493
Other Asia and Oceania	198,797	27,977
Other countries	8,382	1,325
Total	19,095,438	2,109,347
Milk		1,090,051

WOOL AND WOOL MANUFACTURES.

IMPORTS.

We imported wool and manufactures of wool to the value of $38,362,001 during the calendar year 1902, this being the largest amount in any year since the change of tariff in 1897 caused the immense importations of that year. The imports of 1901 were considerably less than the above, namely, $29,621,964, so that the excess of last year over 1901 was $8,740,037. This increase was participated in almost equally by the several classes of raw wool, as well as by the manufactures.

Imports of clothing wool increased from a total value of $5,726,006 in 1901 to $7,333,855 for last year, the quantities being 42,877,183 pounds and 55,936,969 pounds, respectively. In regard to values there was little difference in the averages of the importations for the two years quoted, the figures being 13.35 cents per pound for 1901 and 13.11 cents for 1902. The principal territorial sources from which we obtain this class of wool, as given in the Treasury returns, are the three following, namely, South America, United Kingdom, and Asia and Oceania, and the increase of last year was shared by all, although to a greater extent by South America than the others. It may be noted, however, that the South American product is of a much lower grade than the European and Australian staple.

The imports of combing wool increased fully 100 per cent last year over the year before; they were, however, no larger than the imports of two years ago. The totals for last year were 11,100,701 pounds, valued at $2,003,527, which is equivalent to 18.05 cents per pound; the corresponding average for 1901 was 18.59 cents. More than half the combing wool imported comes through the United Kingdom, and the best part of the remainder comes from British North America. This class of wool is the most expensive which we import, and it

includes a considerable quantity of mohair (Angora goat hair), the domestic supply of which is well known to be inadequate.

The importations of carpet wool in 1902 amounted to 109,254,969 pounds, with a value of $10,252,845. This is about one-third greater than the business of 1901, the totals for that year having been 76,808,998 pounds, with a value of $7,310,132. The respective averages per pound were 9.52 cents for 1901 and 9.38 cents for last year. Thus it will be seen that all classes of raw wool were a little higher in price in 1901 than they were last year. The carpet wool received at our ports comes chiefly from the United Kingdom, other Europe, China, and South America, in the order named. The greatest increase in 1902 occurred in the imports from China, which were more than double those of 1901.

Manufactures of wool are divided in the returns into several classes, the names of which, together with the quantity and value of the imports of each for 1902, are as follows: Carpets and carpeting, 1,053,648 square yards, valued at $3,593,538; ready-made clothing, value, $1,802,968; cloths, 4,975,918 pounds, with a valuation of $5,054,384; dress goods, 36,538,040 square yards, valued at $6,775,042; knit fabrics, value, $738,884; mungo, flocks, rags, etc., 309,155 pounds, value, $77,124; shawls, value, $44,767; yarns, 465,853 pounds, value, $213,779; all other, valued at $471,288. When compared with 1901 the importations of carpets and carpeting last year show a slight increase, while the business in ready-made clothing was practically the same. Cloths increased about one-fourth, dress goods about one-sixth, and knit fabrics about one-third. There were no changes of moment in any of the other classes of manufactures. More than half the carpets and carpeting we import comes from continental Europe; about 70 per cent of the cloths is furnished by the United Kingdom and most of the residue by Germany; the major part of the dress goods is also supplied by the United Kingdom, but France is a large contributor in this class as well, and Germany sends nearly all the remainder.

EXPORTS.

There being a large shortage of raw wool in the country, it necessarily follows that the exports of the domestic product would be of little extent. The quantity sent abroad last year was 445,702 pounds, valued at $63,814, and although these totals are small they are nevertheless a big increase on the figures of the year previous. The average value per pound of the exports of 1902 was 14.32 cents, and this, it may be noted, is about 1 cent per pound higher than the average price of foreign clothing wool imported in the same year.

There was a slight increase in the total value of the exports of domestic manufactures of wool in 1902, the total being $1,588,058, as

against $1,531,777 for 1901; and it will be seen from the table that there has been a small but steady increase in the totals in each year, with one slight exception, of the eleven shown on the list. Of the different classes of manufactures exported by us, wearing apparel is the one in which the largest amount of traffic is done, and there was a larger increase in this class last year than in any other.

The following tables show the annual values of the imports and exports of the different classes of wool, together with the manufactures, since 1892:

Value of imports of wool and wool manufactures for the years 1892 to 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Calendar year.	Class 1 (clothing wool).	Class 2 [a] (combing wool).	Class 3 (carpet wool).	Manufactures.	Total.
1892	$9,309,640	$1,375,651	$10,505,348	$37,515,445	$58,703,084
1893	5,373,238	895,266	7,485,045	30,238,506	44,182,055
1894	5,315,919	1,166,150	6,780,443	17,342,682	30,605,194
1895	19,657,912	4,092,656	10,019,591	60,319,331	94,089,490
1896	13,077,712	2,032,169	7,311,533	37,109,363	59,530,777
1897	33,953,828	6,946,102	12,532,300	29,330,284	82,762,214
1898	4,639,220	301,337	6,646,019	13,834,296	25,420,872
1899	2,803,680	1,499,276	7,356,688	14,596,847	26,256,491
1900	8,498,228	2,235,096	8,476,738	15,806,112	35,016,174
1901	5,726,006	981,294	7,310,132	15,604,532	29,621,964
1902	7,333,855	2,003,527	10,252,845	18,771,774	38,362,001

[a] Includes mohair, camel's hair, etc.

Value of exports of wool and wool manufactures for the years 1892 to 1902.

Calendar year.	Raw wool.	Manufactures.	Total.
1892	$38,799	$273,835	$312,634
1893	36,139	559,379	595,518
1894	232,162	736,360	968,522
1895	689,874	782,855	1,472,729
1896	968,866	945,103	1,913,969
1897	144,608	1,058,956	1,203,564
1898	14,406	1,020,810	1,035,216
1899	566,295	1,229,539	1,795,834
1900	59,338	1,429,733	1,489,071
1901	15,039	1,531,972	1,547,011
1902	63,814	1,588,058	1,651,872

The next statement gives a detailed view of the trade in wool and wool manufactures for the year 1902, showing the origin of the different classes of imports and the distribution of the exports.

Quantity and value of imports and exports of wool and wool manufactures (including hair of goat, camel, etc.) for the calendar year 1902, by countries.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

IMPORTS.

Country from which imported.	Quantity.	Value.
CLASS 1.—*Clothing wool.*	*Pounds.*	*Dollars.*
United Kingdom	17,691,119	2,703,586
France	300	19
South America	24,424,986	2,289,960
Asia and Oceania	13,341,405	2,271,487
Other countries	479,159	68,803
Total	55,936,969	7,333,855
CLASS 2.—*Combing wool.*		
United Kingdom	7,748,594	1,411,958
Other Europe	793,069	163,262
British North America	2,094,444	310,761
South America	259,754	75,967
Asia and Oceania	204,820	41,574
Other countries	20	5
Total	11,100,701	2,003,527
CLASS 3.—*Carpet wool.*		
United Kingdom	37,555,623	3,873,553
France	4,224,837	443,533
Germany	3,023,516	319,747
Other Europe	23,898,909	2,389,028
British North America	3,556	425
South America	11,261,945	743,319
Chinese Empire	20,779,737	1,599,253
Other Asia and Oceania	8,012,388	826,056
Other countries	494,458	57,931
Total	109,254,969	10,252,845
Total unmanufactured	176,292,639	19,590,227
MANUFACTURES.		
Carpets:	*Sq. yards.*	
United Kingdom	248,408	566,888
Other Europe	644,209	2,535,302
Japan	1,395	1,821
Other Asia and Oceania	155,726	479,768
Other countries	3,910	9,759
Total	1,053,648	3,593,538
Clothing	------------	1,802,968

Quantity and value of imports and exports of wool and wool manufactures, etc.—Continued.

Country from which imported.	Quantity.	Value.
Cloths:	*Pounds.*	*Dollars.*
United Kingdom	3,230,780	3,336,682
Austria-Hungary	119,696	110,073
Belgium	239,789	222,317
France	212,944	265,886
Germany	1,144,739	1,092,275
Other Europe	7,198	6,635
Other countries	20,772	20,516
Total	4,975,918	5,054,384
Dress goods:	*Sq. yards.*	
United Kingdom	22,127,805	3,389,747
France	9,610,280	2,257,576
Germany	4,752,340	1,114,522
Other Europe	29,792	8,959
Other countries	17,823	4,238
Total	36,538,040	6,775,042
All other manufactures		1,545,842
Total manufactures		18,771,774

EXPORTS.

	Pounds.	*Dollars.*
Raw wool	445,702	63,814
Manufactures:	*Sq. yards.*	
Carpets	98,509	78,143
Dress goods	9,547	7,037
Flannels and blankets		43,627
Wearing apparel		1,129,785
All other		329,466
Total		1,588,058

HIDES AND SKINS.

The imports of hides and skins (other than furs) have been on the increase for a number of years, and a further advance is noted last year, when the figures reached the large total of 325,106,531 pounds, with a valuation of $57,732,397, while those of 1901 were 310,539,594 pounds, with a value of $55,565,388. It will be seen that both quantity and value for 1902 are the largest on the list. There was also an increase in the export totals last year, but these are of little account when compared with the imports.

Hides and skins constitute much the largest single item on the whole list of imports of animal products. The total value of the imports of animal origin for the past year, as shown on page 491, was $127,909,553, while the value of the hides and skins purchased from foreign sources,

as given above, was $57,732,397; thus the proportion of the latter was not far short of one-half of the total.

The Treasury reports divide the imports of hides and skins into three classes, namely, goatskins, hides of cattle, and all other; the first and last of these are admitted free of duty, hides of cattle only being subject to the tariff. There was a decrease in the importations of goatskins last year, the totals being 83,115,160 pounds, valued at $24,171,569, as against 87,694,449 pounds, valued at $25,265,670, for 1901. But this decrease was more than offset by the increases in the other classes. Hides of cattle advanced from 138,361,626 pounds, valued at $16,002,526, in 1901, to 142,995,036 pounds, with a value of $16,871,656, last year. But the greatest increase was in miscellaneous hides and skins, which went from 84,137,912 pounds, valued at $14,297,816, to 98,996,335 pounds, valued at $16,689,172.

The respective average prices of the several classes of hides and skins imported in 1902 were as follows: Goatskins, 29.08 cents per pound; hides of cattle, 11.80 cents per pound; all other, 16.86 cents per pound.

The returns do not give the countries of origin for the separate classes, but only for all hides and skins in bulk. As such, we find that large quantities come from widely separated parts of the globe, the principal of which are South America, which supplies about 25 per cent of the total, the East Indies, which is a close second, and other Europe, United Kingdom, France, other Asia and Oceania, Germany, and Mexico, in the order named.

The exports of domestic hides and skins in 1902 amounted to 10,991,603 pounds, valued at $1,025,157, which is equivalent to 9.33 cents per pound. It may be stated in passing that about an equal quantity of foreign hides and skins were exported in addition. The domestic exports are nearly all taken by British North America and Germany in about equal portions, the cheaper grades going to the latter country.

The tables which follow show our foreign trade in hides and skins annually since 1896, as well as a detailed statement of the imports and exports of 1902. The total trade is shown first, as follows:

Imports and exports of hides and skins for the years 1896 to 1902.

Calendar year.	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
1896	146,159,006	20,713,528	42,009,166	3,481,364
1897	236,372,088	33,220,749	18,778,031	1,553,622
1898	256,188,970	39,906,373	11,397,129	1,018,433
1899	318,261,631	51,127,659	7,514,483	769,927
1900	307,315,840	51,587,993	10,635,394	1,051,435
1901	310,539,594	55,565,388	8,736,495	860,961
1902	325,106,531	57,732,397	10,991,603	1,025,157

The geographical distribution of the imports and exports of 1902 is given in the following table:

Quantity and value of imports and exports of hides and skins (other than furs) for the calendar year 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Country from which imported or to which exported.	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
United Kingdom	36,352,121	5,896,033	342,405	36,212
Belgium			30,954	2,863
France	31,103,591	5,790,481	125,279	14,145
Germany	20,472,290	3,824,237	5,565,901	417,124
Netherlands			221,680	54,870
Other Europe	45,278,617	7,794,728	226,421	26,801
British North America	23,247,453	2,022,552	4,297,261	450,084
Central American States	3,930,169	600,878		
Mexico	20,636,098	3,611,628	19,283	2,842
West Indies and Bermuda	2,215,345	493,887	13,760	1,951
South America	75,092,186	12,636,414		
Japan			103,834	12,515
East Indies	41,542,421	9,144,284		
Other Asia and Oceania	21,890,343	5,209,092	44,825	5,750
Africa	3,311,285	705,321		
Other countries	34,612	2,862		
Total	325,106,531	57,732,397	10,991,603	1,025,157

Lastly is given a statement showing the annual status of the imports of goatskins, morocco leather, and gloves from 1896 to 1902, inclusive.

Statement of annual imports of goatskins, morocco skins, and gloves for the years 1896 to 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Calendar year.	Goatskins.		Morocco leather.	Gloves.
	Quantity.	Value.	Value.	Value.
	Pounds.	*Dollars.*	*Dollars.*	*Dollars.*
1896	38,882,234	8,803,609	2,808,322	5,618,311
1897	59,177,556	13,802,504	3,748,341	6,337,410
1898	65,546,570	16,854,430	2,452,655	5,686,464
1899	80,064,583	20,992,949	2,831,035	5,544,871
1900	69,104,372	19,008,097	2,940,949	6,433,941
1901	88,043,928	25,265,670	2,399,603	5,060,224
1902	83,115,160	24,171,569	2,037,556	5,135,590

These items are placed together in this way in order to show at a glance the extent of our dependence upon foreign countries for goatskins and goatskin products. In comparing the totals of last year with those of 1901 it will be seen that there was a little improvement in the condition of things because of some falling off in our purchases of goatskins and morocco leather, and although there was a slight increase in gloves, the difference was so small as to have little effect on the general total, which showed an aggregate decrease of over

$1,250,000. However, last year's total was yet considerably in excess of all the others on the list excepting that of 1901.

The total value of the goatskin products for 1902, as shown in the statement above, was $31,344,715, while that of all animal products, as previously stated, was $127,909,553; thus the three products in question were responsible for no less than 25 per cent of the entire imports of animal origin for that year. These facts are sufficiently eloquent of the smallness of the goatskin industry in the United States.

LEATHER AND LEATHER MANUFACTURES.

Our foreign trade in these commodities continued in a satisfactory condition last year, there having been, as was also the case the year before, a diminution in the imports and an advance in the exports, thus showing an increasing balance of trade in our favor. The statement below shows that the commerce in leather has all along been much to our advantage, but it is only in the last two years that we have more than held our own in the manufactures, and this is entirely owing to the great increase in our boot-and-shoe trade.

The imports of leather in 1902 totaled $5,051,361 as against $5,507,377 in 1901, or a decrease of $456,016. These imports consist almost entirely of morocco skins and dressed upper leather—in about equal proportions. On the other hand, the exports of domestic leather increased upward of a million dollars last year, the total value going from $21,776,362 in 1901 to $22,820,396 last year. The leather which we ship abroad is composed of about two-thirds splits, buff, grain, and other upper leather, and one-third sole leather. The United Kingdom is the chief consumer of our exports, the large amount of $16,184,894 worth out of the total of $22,820,396 having been sent to British ports in 1902; the remainder is distributed in smaller quantities among a large number of countries, with Netherlands, Australia, Germany, and Belgium predominating.

In regard to the manufactures, about five-sixths of the imports is composed of gloves, while fully as large a ratio of the exports consists of boots and shoes. The value of the imports of 1902 was $6,160,409, and of the exports $7,730,676, both these amounts being slightly larger than the figures for 1901.

A glance down the last column of the first table below will show with what rapidity the American shoe is winning its way into foreign countries. Our exports of boots and shoes now reach remote parts of the earth, but, with a few exceptions, not as yet in large quantities. About one-third of our total shipments last year went to the United Kingdom, the next largest consumers being the West Indies, Australia, Mexico, and British North America.

The gloves which we import come mostly from France and Germany, and in lesser quantities from other European countries.

The accompanying tables show, first, the imports and exports of leather and leather manufactures annually (in bulk) since 1896, and, second, the same in detail for the calendar year 1902.

Value of imports and exports of leather and leather manufactures for the years 1896 to 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

Calendar year.	Leather.		Leather manufactures.	
	Imports.	Exports.	Imports.	Exports.
1896	$5,104,571	$16,279,947	$6,103,713	$2,597,510
1897	6,373,726	16,321,849	6,789,576	2,904,819
1898	5,236,171	18,682,843	6,113,256	3,233,979
1899	5,750,937	22,104,451	6,143,380	4,705,382
1900	6,196,687	21,297,539	7,101,109	5,871,475
1901	5,507,377	21,776,362	5,868,628	7,173,087
1902	5,051,361	22,820,396	6,160,409	7,730,676

Quantity and value of imports and exports of leather and leather manufactures for the calendar year 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

IMPORTS.

Article and country of import or export.	Quantity.	Value.
	Pounds.	*Dollars.*
Leather:		
Band or belting and sole leather		73,323
Calfskin, tanned, etc		534,411
Skins for morocco		2,037,556
Upper leather and skins, dressed, etc		2,406,071
Total leather		5,051,361
Leather manufactures:		
Gloves—		
Belgium		128,015
France		2,034,152
Germany		1,929,761
Other Europe		1,013,276
Other countries		406
Total		5,135,590
All other manufactures		1,024,819
Total manufactures		6,160,409

EXPORTS.

Sole leather:		
United Kingdom	32,491,406	5,716,988
Belgium	873,763	183,404
Germany	76,470	15,317
Italy	171,534	32,538
Netherlands	146,441	29,465
Other Europe	1,242,993	251,183
British North America	630,203	124,069
West Indies and Bermuda	32,125	8,333
South America	37,364	10,641
Japan	803,047	214,7[illegible]1
British Australasia	126,820	33,923
Philippine Islands	11,237	3,635
Other Asia and Oceania	60,616	16,807
British Africa	255,950	56,357
All other Africa	3,356	492
Other countries	94,158	23,103
Total	37,057,483	6,720,966

Quantity and value of imports and exports of leather and leather manufactures for the calendar year 1902—Continued.

EXPORTS—Continued.

Article and country of import or export.	Quantity.	Value.
Upper and other leather:	*Pounds.*	*Dollars.*
United Kingdom		10,467,906
Belgium		606,182
France		507,493
Germany		774,246
Italy		99,322
Netherlands		1,154,633
Other Europe		556,144
British North America		527,652
Central American States and British Honduras		63,227
Mexico		13,573
Cuba		68,348
Other West Indies and Bermuda		41,429
Argentina		56,901
Brazil		155,119
Chile		28,398
Colombia		14,297
Venezuela		27,406
Other South America		25,854
British Australasia		784,818
Philippine Islands		16,765
Other Asia and Oceania		58,302
British Africa		34,205
All other Africa		16,928
Other countries		282
Total		16,099,430
Total leather		22,820,396
Boots and shoes:		
United Kingdom		2,088,315
Belgium		23,876
France		110,391
Germany		267,766
Netherlands		19,409
Other Europe		46,020
British North America		591,829
Central American States and British Honduras		121,383
Mexico		680,607
West Indies and Bermuda		995,991
Colombia		80,514
Other South America		91,679
British Australasia		865,148
Philippine Islands		77,038
Other Asia and Oceania		52,176
British Africa		344,300
All other Africa		12,015
Other countries		1,955
Total		6,470,412
Harness and saddles		339,999
All other manufactures		920,265
Total manufactures		7,730,676

COMMERCE WITH OUR ISLAND POSSESSIONS.

Appended is a tabular statement giving the imports and exports of animals and animal products between the United States and the three principal oversea Territories—Porto Rico, the Philippine Islands, and the Hawaiian Islands; the commerce being shown in as much detail as the Treasury returns allow. It should be noted that the trade with Hawaii is given for six months only; this is because no exact data of our exports to that Territory prior to June 30, 1902, are available.

Commerce of the United States, in animals and animal products, with Porto Rico, the Philippine Islands, and the Hawaiian Islands for the calendar year 1902.

[Compiled from reports of the Bureau of Statistics, Treasury Department.]

PORTO RICO.

Article.	Shipments from United States.		Shipments to United States.	
	Quantity.	Value.	Quantity.	Value.
Animals ... number		$4,525	[a] 7	$405
Bones, hoofs, horns, etc				3,131
Boots and shoes ... pairs	247,119	238,275		
Other leather and manufactures		70,313		
Hides and skins (other than furs) ... pounds			682,910	78,881
Provisions:				
Beef products		61,762		
Hog products		1,102,087		
Other meat products		106,725		
Dairy products		184,586		
Tallow ... pounds			64,362	3,057
Wool manufactures		111,845		
Total		1,880,118		85,474

PHILIPPINES.

Article.	Shipments from United States: Quantity.	Value.	Shipments to United States: Quantity.	Value.
Bone and horn manufactures				$42
Leather and manufactures		$134,174		
Provisions (meat and dairy products, etc.)		177,976		
Wool manufactures		15,051		
Total		327,201		42

HAWAII. [b]

Article.	Shipments from United States: Quantity.	Value.	Shipments to United States: Quantity.	Value.
Animals		$29,645		
Bones, hoofs, horns, etc				$397
Hides and skins ... pounds			840,540	77,853
Leather and manufactures		159,580		3,759
Provisions (meat and dairy products, etc.)		307,149		
Wool, raw ... pounds			274,705	32,708
Wool manufactures		102,303		5,468
Total		598,677		120,185

[a] Horses. [b] For six months ended December, 1902.

LIVE STOCK AND THE MARKETS.

The series of tables on the succeeding pages show the receipts and shipments of the different farm animals at the various stock centers during the year 1902. It is well to call attention to the fact that the totals necessarily include many duplications, because many animals are counted as receipts at one city and then passed on to one or more places where they are again enumerated before being finally disposed of. However, the figures as given serve a twofold purpose—namely, (1) to show the movement of stock at each center and (2) by noting the difference between the receipts and shipments, to find, in a general way, the local consumption in each case, including, of course, the packing.

Following the receipts and shipments will be found tables giving the average weight of hogs at leading centers for a series of years and also statements of the range and average prices of the different classes of cattle, hogs, sheep, and horses at Chicago and Omaha:

Receipts and shipments of live stock, 1900 to 1902.

Animals.	1900.		1901.		1902.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
	Number.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
Cattle	10,135,096	4,954,400	10,807,494	4,205,708	11,396,925	4,788,991
Calves	991,321	169,555	1,104,890	246,321	1,289,835	250,751
Hogs	33,134,838	12,563,979	34,464,424	7,524,444	30,520,945	7,270,307
Sheep	15,535,925	7,545,409	15,803,068	5,821,635	17,573,466	6,884,230
Horses and mules	742,607	658,507	695,997	523,592	616,840	485,949
Total	60,539,787	25,891,850	62,875,873	18,321,700	61,398,011	19,680,228

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Summary of receipts and shipments of live stock at leading cities during the calendar year of 1902.

Stock center.	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
	Number.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
Chicago	2,941,559	909,915	251,747	26,770	7,895,238	1,251,798	4,515,716	831,728	102,100	96,432
Kansas City	2,082,541	979,517	196,625	81,569	2,279,337	37,524	1,154,084	411,292	76 844	72,766
Omaha	1,010,815	364,823			2,247,428	169,708	1,742,539	863,250	42,079	39,959
South St. Paul	265,681	201,663	40,345	27,817	668,585	28,645	602,332	484,912	8,152	7,860
St. Paul	93,053	92,805			464	464	348,219	336,893	2,199	2,277
Sioux City	399,128	310,048	5,707	2,369	1,007,762	143,121	61,275	26,083	19,151	18,596
St. Louis	25,245	3,961	6,785		226,661	15,739	12,342	1,667		
National Stock Yards	1,112,942	315,569			1,329,819	143,455	523,201	71,765	109,295	85,264
Indianapolis	214,568	79,967			1,323,601	431,624	103,411	67,275	35,779	29,787
St. Joseph	494,016	105,717	23,278	5,951	1,697,741	91,044	560,653	128,537	19,909	19,306
Milwaukee	46,513	11,984	45,480	1,635	463,856	5,951	50,480	5,028	2,333	1,189
Pittsburg	128,301		41,141		757,908		553,631			
Lincoln	156,627				11,130		171,534			
Cincinnati	198,092	48,308	47,438	2,088	771,987	263,360	427,281	305,379	8,699	6,050
Cleveland	32,768	204	4,664		782,691	381,611	157,728	6,461		
Philadelphia	136,935	38,369	40,989	1,167	239,688	7,604	524,531	68,172	20,877	6,973
Baltimore	147,661	92,186	33,167	3,581	589,126	132,907	398,545	215,548	6,938	5,848
East Buffalo	550,000	470,910	35,200	11,600	4,513,280	3,454,080	1,976,200	1,653,800	62,940	56,639
Louisville	141,991	78,556	14,194	3,375	665,670	340,548	278,821	227,642	3,642	3,120
Detroit	67,349	25,293	16,082	3,465	340,931	62,916	146,266	54,598	213	177
Jersey City	133,890	117,274	70,035	29,022	349,883		1,307,202	693,624		1,020
New York	146,112		255,035		533,228		599,812		3,852	
Denver	324,154	292,375			86,685	6,145	316,594	259,109	24,428	22,286
Pueblo	148,556	80,425			10,615	142	208,151	7,796	13,277	4,501
Fort Worth	132,122	129,478			79,072	68,579	9,622	9,254	4,872	1,300
Portland, Oreg	26,005	19,465			38,975	31,925	115,475	89,360	4,380	2,275
San Francisco	40,332		5,145		86,949		173,691			
Weehawken, N. J	20,179	20,179	50,402	50,402	201,417	201,417	65,057	65,057	2,324	2,324
Boston	179,790		106,376		1,321,218		466,073		42,557	
Total	11,396,925	4,788,991	1,289,835	250,751	30,520,945	7,270,307	17,573,466	6,884,230	616,840	485,949

Receipts and shipments of live stock at leading cities in 1902.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
CHICAGO.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number,*	*Number.*
January	275,180	80,136	12,691	2,054	887,423	104,706	372,412	41,211	10,303	10,062
February	230,329	72,234	14,306	1,500	873,180	173,445	265,946	28,483	10,086	10,156
March	233,560	69,649	17,968	1,378	741,568	193,705	260,862	46,407	15,516	13,717
April	211,769	67,372	34,859	1,944	556,929	133,177	254,129	41,179	12,824	12,418
May	186,901	52,387	30,000	1,669	640,245	105,330	258,516	37,033	10,341	10,399
June	204,813	57,172	23,476	1,201	680,289	88,436	299,172	16,860	6,928	6,553
July	216,063	62,475	21,913	1,345	461,055	71,593	337,134	31,732	4,420	4,354
August	228,450	74,797	23,997	1,849	482,932	102,307	379,951	62,885	4,940	4,543
September	291,040	97,119	26,714	3,315	434,161	81,388	492,052	128,148	7,200	6,046
October	309,396	108,779	18,139	3,964	518,500	68,816	613,547	200,208	7,978	7,380
November	253,292	77,767	14,792	3,254	724,588	49,678	487,763	117,508	6,221	5,836
December	300,766	90,028	12,892	3,297	894,368	79,217	494,232	80,074	5,343	4,968
Total	2,941,559	909,915	251,747	26,770	7,895,238	1,251,798	4,515,716	831,728	102,100	96,432
KANSAS CITY.[a]										
January	133,654	51,549	3,983	924	308,071	2,952	52,459	3,656	8,574	10,286
February	97,093	37,471	3,409	1,087	240,805	3,193	44,414	2,247	9,085	7,577
March	103,032	42,757	3,982	681	160,029	7,876	59,488	6,593	9,976	9,200
April	97,615	44,384	3,185	853	157,601	5,539	57,966	9,485	7,102	8,325
May	79,362	33,803	3,512	387	188,344	3,847	70,697	20,489	4,614	5,116
June	110,170	41,643	13,138	3,038	169,517	1,962	85,927	27,760	3,016	3,242
July	189,785	75,463	24,218	6,041	117,565	1,168	66,590	20,140	2,677	2,562
August	242,653	131,082	28,181	11,773	109,542	2,683	106,797	49,854	4,307	3,392
September	332,199	175,747	40,464	17,705	140,419	3,923	168,314	73,975	6,924	5,405
October	295,209	170,551	36,246	15,914	285,787	3,305	207,328	115,144	7,575	6,543
November	222,490	101,890	24,088	14,793	219,789	533	127,007	54,203	6,984	5,633
December	179,279	73,177	12,219	8,373	181,868	543	107,097	27,746	6,010	5,485
Total	2,082,541	979,517	196,625	81,569	2,279,337	37,524	1,154,084	411,292	76,844	72,766

[a] Figures do not include 112,503 cattle, 13 calves, and 16,842 sheep driven out as feeders.

Receipts and shipments of live stock at leading cities in 1902—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
OMAHA.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January	73,908	14,706			230,379	2,653	54,875	6,259	1,312	1,019
February	61,408	11,871			243,941	4,996	71,572	15,065	1,843	1,635
March	63,897	18,700			202,624	9,030	105,361	28,109	2,031	1,821
April	67,497	23,795			190,796	27,081	81,743	26,008	1,572	1,455
May	50,646	18,498			222,246	33,610	45,607	7,977	1,856	1,812
June	47,437	13,598			241,437	37,949	60,701	18,574	4,320	3,753
July	55,525	14,418			173,214	29,593	115,553	45,004	7,895	7,996
August	96,182	45,229			160,904	21,609	198,638	109,297	7,846	4,561
September	155,129	77,277			90,768	2,750	285,876	186,841	8,123	6,918
October	148,038	74,998			109,994		334,882	227,900	5,613	6,274
November	103,607	35,469			155,896	437	221,942	131,316	1,599	1,669
December	87,541	16,264			225,229		165,789	60,900	1,069	1,046
Total	1,010,815	364,823			2,247,428	169,708	1,742,539	863,250	42,079	39,959
SOUTH ST. PAUL.										
January	11,776	5,993	1,626	657	74,006	2,349	62,341	45,592	32	32
February	13,178	7,923	2,029	905	56,656	600	44,774	39,402	125	229
March	17,134	10,621	4,100	3,067	50,848	1,268	32,194	33,597	173	115
April	21,606	14,317	8,679	7,585	52,902	1,001	11,954	35,735	148	165
May	8,326	6,731	5,156	4,387	58,846	746	3,292	24,373	243	198
June	9,946	6,513	4,621	3,254	48,321	2,067	9,259	11,144	721	731
July	13,606	9,595	2,874	1,531	40,512	904	11,908	7,008	2,812	1,157
August	29,216	22,083	1,638	911	19,595	575	29,037	20,264	1,361	2,763
September	55,153	46,454	3,606	1,784	24,163	503	77,444	60,018	743	809
October	52,728	49,198	2,919	1,940	50,323	936	147,965	111,779	969	868
November	22,411	16,317	1,825	1,277	88,300	7,424	132,133	81,947	587	581
December	10,601	5,918	1,272	519	104,113	10,272	40,031	14,053	238	212
Total	265,681	201,663	40,345	27,817	668,585	28,645	602,332	484,912	8,152	7,860

SIOUX CITY.										
January	25,336	17,204	182	29	93,155	3,785	5,336	286	185	197
February	22,384	15,993	159	31	95,360	7,692	3,402	408	1,550	1,612
March	31,879	22,428	358	116	73,253	3,116	4,006	193	853	864
April	31,104	25,978	361	69	78,054	3,146	4,201	513	314	276
May	42,801	43,925	274	84	101,196	8,668	3,975		790	832
June	48,232	40,160	176	23	96,647	11,659	3,268	1,896	4,954	4,971
July	23,769	15,611	819	652	73,319	4,243	4,094	1,827	3,002	2,970
August	24,619	16,973	178	25	74,946	9,489	3,385	1,861	1,482	1,318
September	52,320	38,455	1,350	546	45,679	2,115	3,322	999	3,667	3,005
October	49,452	40,761	1,278	600	57,724	1,128	7,676	5,633	1,803	2,021
November	27,049	19,090	362	145	90,597	22,299	11,862	8,773	276	273
December	20,183	13,4[illegible]0	210	49	127,832	65,781	6,748	3,694	270	257
Total	399,128	310,048	5,707	2,369	1,007,762	143,121	61,275	26,083	19,151	18,596
ST. LOUIS.										
January	1,798	127	264		23,522	406	474			
February	1,613	337	240		17,364	998	450	91		
March	1,822	72	689		19,004	1,565	417			
April	2,782	508	918		19,371	1,680	1,030			
May	2,431	326	770		22,577	2,273	1,360	462		
June	2,174	227	746		16,695	903	1,319	241		
July	2,070	470	700		11,906	458	614	140		
August	2,016	340	643		15,613	751	960	149		
September	2,071	451	610		20,133	3,329	1,586	131		
October	2,187	219	518		22,972	2,803	1,309	147		
November	2,111	444	368		17,580	251	1,113	196		
December	2,170	440	319		19,924	322	1,710	110		
Total	25,245	3,961	6,785		226,661	15,739	12,342	1,667		

Receipts and shipments of live stock at leading cities in 1902—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
NATIONAL STOCK YARDS.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January	67,584	8,514			183,626	16,185	25,138	474	12,509	10,019
February	63,736	11,910			130,606	17,365	18,556	324	9,900	8,610
March	53,569	8,368			91,998	18,008	23,350	671	10,850	8,454
April	57,214	10,918			89,290	15,762	28,794	1,888	9,108	6,225
May	57,238	13,915			98,415	14,585	63,779	15,008	6,523	5,909
June	97,258	27,716			82,312	7,509	72,669	19,584	5,744	3,602
July	120,360	40,564			71,598	7,697	59,862	7,535	6,172	5,221
August	118,040	42,867			72,916	7,457	49,292	6,648	7,232	4,714
September	148,226	53,152			113,186	10,940	52,484	6,970	11,965	8,219
October	134,368	45,096			152,548	13,531	47,040	4,644	11,740	9,937
November	101,863	31,164			128,465	5,860	33,910	3,325	9,424	7,525
December	93,486	21,385			114,919	8,556	48,327	4,694	8,128	6,829
Total	1,112,942	315,569			1,329,819	143,455	523,201	71,765	109,295	85,264
INDIANAPOLIS.										
January	21,291	8,360			153,758	65,006	9,831	7,417	4,075	3,632
February	15,928	6,302			99,375	37,941	5,011	3,148	3,358	2,909
March	15,329	6,198			71,910	25,859	5,086	3,145	4,082	3,643
April	16,868	5,769			70,820	16,139	3,494	1,871	4,348	3,862
May	14,425	5,655			107,615	22,684	10,543	6,773	2,911	2,655
June	18,931	7,393			110,339	24,532	10,694	6,423	1,608	1,255
July	18,611	7,100			100,115	46,962	11,421	7,876	2,511	1,821
August	18,685	7,255			93,659	36,388	10,586	6,698	2,367	1,767
September	18,151	6,252			80,591	27,991	7,000	3,739	2,814	2,150
October	19,996	7,288			114,132	42,467	12,115	8,159	3,024	2,460
November	15,799	5,498			154,369	34,968	6,660	3,669	2,731	1,919
December	20,554	6,897			166,918	50,687	10,969	8,357	1,950	1,714
Total	214,568	79,967			1,223,601	431,624	103,411	67,275	35,779	29,787

ST. JOSEPH.										
January	31,699	6,384	826	457	185,134	261	12,897	58	1,375	1,055
February	24,106	5,935	935	529	185,824	8,641	20,192	1,797	1,157	1,257
March	22,452	5,867	1,031	502	146,293	4,954	59,921	14,067	1,852	1,695
April	27,268	6,429	959	509	130,087	6,379	89,241	19,857	1,240	1,328
May	18,521	5,750	669	206	162,649	13,106	56,269	2,874	621	750
June	25,091	5,235	1,004	143	171,635	17,398	25,463	4,238	1,891	1,724
July	43,769	6,097	2,380	249	128,765	15,702	28,309	2,538	1,499	1,578
August	48,039	11,323	3,686	336	114,286	16,437	56,609	13,766	3,028	2,940
September	76,853	19,915	3,715	945	81,434	6,175	66,561	16,024	2,464	2,244
October	70,773	18,060	3,998	755	116,135	705	77,306	34,504	1,916	1,982
November	53,864	9,015	2,443	788	121,670	363	34,127	14,891	1,582	1,575
December	51,581	5,707	1,632	532	153,829	923	33,758	3,913	1,284	1,178
Total	494,016	105,717	23,278	5,951	1,697,741	91,044	560,653	128,537	19,909	19,306
MILWAUKEE.										
January	3,904	1,391	2,365	39	47,056	391	2,751	334	181	179
February	3,457	1,031	2,580	154	32,508	112	1,826	79	194	115
March	3,175	827	3,520	49	31,535		1,175	242	368	225
April	3,702	670	6,326		37,704		945		159	92
May	3,319	551	6,757	349	31,712	169	2,622	276	242	16
June	3,488	609	6,729	806	24,652	67	3,562	244	241	23
July	4,242	1,399	4,836	36	19,790	286	5,524	284	194	89
August	3,270	906	2,791	26	15,356	237	6,221	611	172	129
September	4,911	1,165	2,600	83	17,546	281	7,015	448	134	52
October	4,382	1,012	2,265	8	49,287	1,039	8,009	298	252	150
November	4,123	1,318	2,314	70	80,780	286	6,250	2,013	124	80
December	4,540	1,105	2,397	15	75,930	3,063	4,480	199	72	39
Total	46,513	11,984	45,480	1,635	463,856	5,951	50,480	5,028	2,333	1,189

Receipts and shipments of live stock at leading cities in 1902—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
PITTSBURG.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January	9,873		1,966		86,380		60,581			
February	7,540		1,908		56,143		48,633			
March	10,388		4,309		46,428		37,872			
April	7,993		9,342		41,665		34,895			
May	8,775		10,097		59,375		61,099			
June	13,991		6,509		68,337		63,683			
July	11,897		5,434		42,095		38,680			
August	10,778		2,788		48,433		37,520			
September	12,697		2,758		63,795		44,299			
October	10,239		2,340		65,549		40,257			
November	10,671		1,842		82,818		35,380			
December	13,459		1,848		96,890		53,822			
Total	128,301		41,141		757,908		556,631			
LINCOLN.										
January	4,752				905		7,568			
February	3,618				962		3,525			
March	2,772				1,283		13,018			
April	7,302				1,216		38,893			
May	14,045				651		30,765			
June	10,060				733		2,041			
July	3,861				649		3,897			
August	18,445				297		3,672			
September	25,626				449		13,391			
October	34,049				1,387		33,867			
November	22,281				700		16,827			
December	9,816				1,898		4,070			
Total	156,627				11,130		171,534			

CINCINNATI.										
January	14,818	2,302	3,203	120	85,540	29,225	11,685	4,201	514	276
February	11,615	1,960	3,133	107	60,562	21,158	6,816	1,750	526	293
March	13,791	1,262	4,285	148	51,253	16,196	6,269	1,027	630	402
April	14,566	3,117	5,205	32	48,767	15,068	7,014	1,052	983	576
May	16,285	4,475	5,358	132	58,421	21,673	21,485	11,955	739	510
June	15,429	2,169	4,846	266	58,062	23,203	78,506	64,618	578	398
July	14,480	3,008	3,968	183	46,273	17,689	113,003	94,648	283	188
August	17,516	6,173	3,495	138	47,341	16,414	86,747	73,101	718	604
September	20,489	6,270	3,548	224	50,277	15,257	34,750	23,695	1,146	875
October	22,592	6,854	3,860	431	74,402	25,061	27,024	13,246	1,113	781
November	17,112	5,163	3,304	228	88,139	28,160	16,574	8,136	877	690
December	19,299	5,555	3,233	79	102,850	34,256	17,398	7,950	592	457
Total	198,092	48,308	47,438	2,088	771,987	263,360	427,281	305,379	8,699	6,050
CLEVELAND.										
January	4,245		221		77,717	39,669	15,526	1,297		
February	3,206		142		45,754	20,965	11,858	876		
March	3,812		434		41,733	18,973	10,659	698		
April	3,424		496		44,798	20,251	9,241	164		
May	2,278		772		66,352	23,635	13,071	99		
June	2,885	24	310		72,675	34,557	10,466	504		
July	2,668		410		46,446	21,315	10,747			
August	1,085	72	356		47,834	24,228	11,559	126		
September	1,896	44	345		53,472	25,237	10,469	552		
October	1,603	16	474		74,695	38,959	17,241	637		
November	2,147		396		107,408	60,491	14,667			
December	3,519	48	308		103,807	53,331	22,224	1,508		
Total	32,768	204	4,664		782,691	381,611	157,728	6,461		

Receipts and shipments of live stock at leading cities in 1902—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
PHILADELPHIA.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January	10,521	1,737	2,784		19,555	717	45,318	4,782	315	703
February	8,322	1,658	2,961	65	19,619	476	40,210	4,698	252	623
March	12,706	2,175	3,197		20,082	1,049	45,630	5,404	388	973
April	10,917	3,437	3,937	200	17,728	90	30,638	7,503	521	915
May	12,191	4,313	3,672	69	23,526	281	41,173	5,995	161	598
June	13,722	3,457	4,078	103	18,846	480	54,373	6,625	144	439
July	10,808	3,452	3,858	165	13,461	436	40,620	6,936	305	406
August	9,877	3,477	3,809	98	13,915	339	57,251	9,610	283	166
September	13,716	4,084	3,828	251	18,240	776	62,194	4,645	241	498
October	10,788	3,720	3,480	123	19,704	378	51,851	3,857	311	580
November	9,695	2,753	2,710	92	23,410	842	42,250	2,416	309	577
December	13,672	4,106	2,675	1	31,602	1,740	13,023	5,701	196	495
Total	136,935	38,369	40,989	1,167	239,688	7,604	524,531	68,172	[a]20,877	6,973
BALTIMORE.										
January	10,083	5,742	1,527	177	61,502	14,556	24,330	9,104	689	473
February	6,905	4,033	1,840	1	55,021	11,341	17,133	4,319	777	703
March	8,968	4,010	2,967	13	55,042	9,860	17,876	4,691	929	713
April	8,063	4,415	3,820	279	49,713	10,707	16,129	4,335	418	309
May	8,539	4,582	4,493	174	45,933	9,613	24,489	12,019	323	271
June	8,393	4,289	3,126	202	41,301	8,246	38,307	20,343	280	196
July	11,468	7,882	3,104	789	34,499	6,847	48,441	33,927	118	110
August	13,525	9,741	2,866	601	34,133	7,532	62,553	37,872	400	206
September	20,037	12,162	3,732	601	45,344	12,269	44,362	28,256	659	609
October	19,700	14,337	3,022	239	50,782	14,388	40,116	22,443	968	955
November	15,993	11,202	1,574	402	57,473	15,147	38,532	22,220	730	621
December	15,987	9,791	1,096	103	58,383	12,401	26,277	16,019	647	682
Total	147,661	92,186	33,167	3,581	589,126	132,907	398,545	215,548	6,938	5,848

EAST BUFFALO.										
January	52,888	46,860	3,400	800	515,840	327,840	235,400	192,200	4,960	4,313
February	43,934	38,258	2,800	800	333,760	263,520	191,000	161,400	5,880	5,548
March	53,108	44,880	3,400	1,200	328,640	249,600	207,400	181,000	11,180	9,690
April	41,250	35,354	2,800	1,200	280,800	221,600	178,000	154,600	8,940	8,683
May	44,198	38,478	2,600	800	342,880	277,600	157,200	130,800	8,080	7,011
June	46,200	39,688	3,000	1,200	340,320	269,760	93,400	70,800	4,160	4,161
July	40,986	35,684	2,400	800	278,400	231,200	86,200	60,600	2,420	2,356
August	46,706	38,214	2,600	800	343,360	276,320	104,600	81,600	2,980	2,451
September	38,940	34,738	2,800	800	359,920	286,400	123,600	111,800	3,880	3,724
October	44,792	37,268	2,800	800	428,800	333,120	185,600	157,200	3,800	3,021
November	48,884	40,414	3,000	1,200	514,880	399,200	200,400	172,200	4,520	3,667
December	48,114	41,074	3,600	1,200	447,680	317,920	213,400	179,600	2,140	2,014
Total	550,000	470,910	35,200	11,600	4,513,280	3,454,080	1,976,200	1,653,800	62,940	56,639
LOUISVILLE.										
January	13,929	7,167	1,067	189	63,783	41,478	1,778	657	346	343
February	10,088	5,595	898	233	51,602	27,582	13,119	996	242	243
March	9,308	4,573	1,165	236	44,366	23,483	2,352	1,432	307	227
April	10,862	6,794	1,406	346	46,043	28,200	5,456	3,850	337	214
May	9,145	5,510	1,273	209	48,865	23,516	23,846	19,363	87	76
June	10,982	4,631	1,495	413	52,776	22,895	35,937	76,669	60	52
July	10,733	6,763	1,352	423	38,450	21,008	79,507	71,894	412	125
August	11,089	6,327	1,286	442	40,287	23,963	45,344	41,983	395	386
September	13,867	7,939	1,192	198	56,424	25,517	15,039	10,443	351	343
October	12,843	6,767	1,036	130	70,043	30,295	9,547	5,607	347	224
November	13,725	7,348	1,056	306	74,985	31,285	3,934	2,179	268	305
December	15,420	8,152	1,013	200	80,046	41,326	4,266	2,369	400	532
Total	141,991	78,556	14,194	3,375	665,670	340,548	278,821	227,642	3,642	3,120

[a] Includes 17,460 horses, estimated as received at West Philadelphia stock yards during the year.

Receipts and shipments of live stock at leading cities in 1902—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
DETROIT.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January	4,921	1,489	960	369	21,207	2,023	15,165	8,430		
February	4,573	1,509	963	349	18,531	941	19,568	13,294		
March	7,027	3,009	1,474	204	27,308	3,285	14,679	7,010		
April	6,225	3,395	1,733	489	28,590	5,481	7,597	2,475	28	19
May	5,701	2,979	1,684	136	29,575	6,076	6,692	1,336	13	13
June	6,890	2,438	1,641	103	29,227	4,178	7,158	963		
July	5,174	1,923	1,171	46	17,414	1,183	7,118	831	51	51
August	4,519	1,628	951	100	16,387	1,971	8,202	1,523	60	60
September	6,778	1,950	1,372	323	29,972	5,898	12,316	1,876	27	26
October	5,433	1,996	1,513	571	35,403	8,260	15,002	4,452	34	8
November	5,148	1,636	1,355	352	45,554	13,786	14,695	5,624		
December	4,960	1,341	1,265	363	41,763	9,834	18,074	6,784		
Total	67,349	25,293	16,082	3,405	340,931	62,916	146,266	54,598	213	177
JERSEY CITY.										
January	13,370	11,987	4,206	2,643	43,300		81,500	24,216		109
February	12,490	11,567	5,040	3,504	31,030		85,320	40,744		84
March	8,600	7,521	5 830	2,738	26,320		78,460	38,506		153
April	8,320	7,086	8,920	2,391	22,200		66,350	27,494		132
May	8,870	7,564	8,940	1,564	21,860		84,400	42,822		25
June	9,540	8,115	6,930	1,802	15,200		135,360	85,064		74
July	9,980	8,356	6,920	2,320	16,420		145,500	85,896		56
August	10,340	9,023	6,160	3,646	30,320		155,320	98,255		69
September	11,650	9,903	5,519	2,548	30,013		145,290	93,384		52
October	13,458	12,020	5,140	2,826	31,640		136,430	81,528		32
November	13,072	11,668	3,610	1,836	39,380		110,220	58,100		6
December	14,200	12,464	2,820	1,174	42,200		83,052	17,615		228
Total	133,890	117,274	70,035	29,022	349,883		1,307,202	693,624		1,020

NEW YORK.										
January	18,293		9,746		44,050		88,175		420	
February	13,238		7,718		40,912		52,591		283	
March	12,705		20,006		50,545		76,628		621	
April	8,615		33,358		38,909		42,113		500	
May	10,953		46,420		47,181		41,220		526	
June	8,651		32,312		35,318		8,712		419	
July	7,805		22,769		28,203		10,284		90	
August	13,482		25,445		37,178		19,945		93	
September	10,970		16,127		34,599		47,415		150	
October	15,571		18,828		46,373		85,782		200	
November	12,166		12,007		62,443		66,283		250	
December	13,663		10,298		67,517		59,664		300	
Total	146,112		255,035		533,228		599,812		3,852	
DENVER.										
January	9,379	7,304			10,998	329	11,715	8,367	2,650	2,620
February	8,279	6,147			9,891	289	17,969	15,315	1,825	1,670
March	10,957	8,755			7,963	80	10,403	6,268	1,553	1,183
April	12,550	9,781			7,983	186	4,456	300	2,092	1,605
May	70,824	66,887			8,522	179	6,718	1,498	2,517	1,862
June	76,490	71,840			5,307	309	5,029	1,990	1,282	1,222
July	16,640	17,237			4,932	108	13,335	8,817	1,421	1,315
August	15,600	12,237			4,294	298	19,619	12,865	1,498	1,489
September	30,790	24,911			5,487	294	32,111	24,922	2,789	2,632
October	29,347	27,872			7,222	889	81,111	69,641	2,139	2,117
November	27,946	25,194			6,829	1,461	92,216	79,503	2,979	2,794
December	15,352	14,210			7,257	1,723	21,912	29,623	1,683	1,777
Total	324,154	292,375			86,685	6,145	316,594	259,109	24,428	22,286

Receipts and shipments of live stock at leading cities in 1902—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
PUEBLO.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January	748	317			2,083	142	1,166	535	374	318
February	564	273			1,225		2,904	2,658	311	311
March	829	642			1,238		1,689	1,218	473	454
April	986	741			1,484		1,812	1,549	237	199
May	29,476	29,246			1,530		246		756	286
June	40,330	39,996			1,342		1,035	694	1,735	1,586
July	8,209	7,868			977		924	654	1,269	1,193
August	3,276	1,342			736		16,703	488	1,259	154
September	12,218						39,719		1,393	
October	15,761						68,751		1,650	
November	25,752						64,756		2,743	
December	10,407						8,446		1,077	
Total	148,556	80,425			10,615	142	208,151	7 796	13,277	4,501
FORT WORTH.										
January	2,426	1,446			10,279	10,510	204	204	873	
February	2,042	2,042			5,270	5,269	291	291	807	
March	3,881	3,881			5,811	1,799	425	425	354	
April	21,575	21,575			5,379	5,330	3,034	3,034	366	
May	29,481	29,481			3,619	3,672	959	959	450	
June	6,304	6,302			3,441	3,376	2,436	2,291	88	
July	9,498	9,308			6,825	6,248	718	865	308	
August	7,809	7,335			6,556	6,400	462	462	287	
September	5,660	6,058			8,625	7,710	234	134	598	
October	8,278	7,958			8,509	8,351	367	204	440	
November	17,049	17,260			5,287	1,771	190	227	110	
December	18,169	16,832			8,970	8,743	302	158	131	
Total	132,122	129,478			79,072	68,579	9,622	9,254	4,872	1,300

PORTLAND, OREG.										
January	1,780	1,370			4,600	3,670	8,105	3,480	280	140
February	2,155	1,615			2,435	2,460	4,095	2,520	705	345
March	1,950	1,490			1,785	1,895	7,715	5,550	290	355
April	2,010	1,780			2,490	1,915	8,115	4,550	210	210
May	3,180	2,650			2,910	3,085	9,395	7,155	1,225	220
June	2,640	2,140			2,155	2,005	11,475	11,190	685	265
July	1,985	1,405			2,410	1,130	13,620	12,190	145	65
August	2,335	1,295			1,210	1,175	15,355	13,140	160	90
September	1,715	1,075			3,360	2,195	6,475	4,365	180	125
October	2,640	1,345			3,825	2,175	16,345	13,955	230	190
November	2,000	1,405			6,810	5,870	5,500	4,725	150	150
December	2,215	1,895			4,985	3,750	9,280	6,540	120	120
Total	26,605	19,465			38,975	31,925	115,475	89,360	4,380	2,275
SAN FRANCISCO.										
January	3,746		582		6,701		16,957			
February	2,793		276		4,668		11,247			
March	3,152		315		4,102		15,232			
April	2,595		351		4,345		14,255			
May	5,019		443		5,082		14,584			
June	2,700		494		2,704		12,790			
July	3,192		492		4,068		19,265			
August	3,842		484		8,322		11,920			
September	3,127		506		9,793		14,778			
October	3,963		395		15,900		16,254			
November	3,357		450		10.111		11,602			
December	2,846		357		11,153		14,807			
Total	40,332		5,145		86,949		173,691			

Receipts and shipments of live stock at leading cities in 1902—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
ST. PAUL, MINN.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January							38,695	11,556		
February	1,059	1,059					8,663	18,958		
March	1,150	1,150					9,217	20,140	158	158
April	1,607	1,607					10,752	35,332		
May	1,003	1,003					220	8,017	10	10
June	38						19,973	22,399	75	75
July	1,628	1,628			91	91	19,824	20,924	515	515
August	20,079	20,075					22,836	22,836	252	176
September	26,833	26,473			98	98	24,271	24,271	415	365
October	27,760	27,657			47	47	90,088	79,525	431	480
November	11,303	11,311			51	51	83,942	67,945	374	373
December	593	842			177	177	19,738	4,990	47	47
Total	93,053	92,805			464	464	348,219	336,893	2,277	2,199
WEEHAWKEN, N. J.										
January	885	885	2,155	2,155	17,735	17,735	11,201	11,201	399	399
February	675	675	1,410	1,410	14,430	14,430	4,450	4,450	155	155
March	535	535	2,833	2,833	16,062	16,062	7,538	7,538	269	269
April	1,499	1,499	5,710	5,710	17,460	17,460	3,263	3,263	142	142
May	3,652	3,652	5,812	5,812	17,013	17,013	2,774	2,774	349	349
June	883	883	6,894	6,894	15,307	15,307	485	485	182	182
July	940	940	4,742	4,742	15,536	15,536	487	487	83	83
August	1,673	1,673	3,721	3,721	15,040	15,040	2,888	2,888	85	85
September	959	959	4,278	4,278	16,777	16,777	8,908	8,908	221	221
October	1,016	1,016	4,401	4,401	18,018	18,018	5,299	5,299	125	125
November	1,532	1,532	3,936	3,936	18,581	18,581	9,081	9,081	191	191
December	5,930	5,930	4,510	4,510	19,458	19,458	8,683	8,683	123	123
Total	20,179	20,179	50,402	50,402	201,417	201,417	65,057	65,057	2,324	2,324

BOSTON.										
January	15,845		5,410		112,599		50,341			
February	14,856		5,394		94,698		29,613			
March	14,763		7,014		96,862		28,890			
April	18,120		15,317		90,252		23,805			
May	16,435		13,408		110,182		25,924			
June	16,102		13,474		107,268		30,575			
July	13,310		12,458		91,660		30,887			
August	13,125		8,832		96,741		38,562			
September	14,840		8,374		105,219		41,522			
October	18,485		8,434		109,172		59,617			
November	18,639		6,686		152,318		61,411			
December	5,267		1,575		154,247		44,926			
Total	179,790		106,376		1,321,218		466,073		42,557	

AVERAGE WEIGHT OF HOGS AT LEADING CENTERS.

Average weight of hogs for a series of years, by months, at leading cities.

CHICAGO.

Month.	1902.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.	1893.
January	203	227	229	231	233	247	236	223	251	217
February	205	224	226	229	227	238	239	220	234	214
March	216	222	223	232	229	230	246	222	232	220
April	210	226	223	231	223	235	243	226	226	225
May	211	227	228	232	225	237	243	227	227	225
June	223	231	229	236	229	240	249	225	233	233
July	230	229	236	237	232	238	249	233	226	237
August	217	238	246	244	243	249	253	237	224	250
September	219	248	247	250	246	252	257	242	232	268
October	220	236	334	240	236	244	242	230	232	267
November	220	218	240	250	235	252	245	241	235	262
December	217	202	238	243	239	245	254	243	229	255
Average for year	216	226	233	237	234	242	246	230	233	240

KANSAS CITY.

Month.	1902.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.	1893.
January	172	213	230	216	218	224	238	216	223	------
February	176	210	218	207	212	225	231	213	220	------
March	188	207	210	203	211	216	232	213	216	------
April	194	207	207	209	209	216	226	213	211	------
May	196	210	213	213	209	217	222	211	212	------
June	198	205	213	209	210	220	221	212	209	------
July	205	187	206	211	217	219	214	213	215	------
August	209	187	219	211	219	217	216	209	199	------
September	208	185	214	211	218	218	226	212	203	------
October	217	199	213	215	215	210	229	220	203	------
November	223	179	216	230	211	221	238	227	220	------
December	224	173	218	222	208	217	232	235	221	------
Average for year	200	197	215	213	213	218	227	216	215	------

SIOUX CITY.

Month.	1902.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.	1893.
January	226	243	254	283	273	281	264	192	------	------
February	222	239	260	257	252	254	258	190	------	------
March	229	238	243	260	254	249	261	200	------	------
April	234	240	244	263	258	234	251	210	------	------
May	228	241	244	263	255	267	271	219	------	------
June	240	245	244	264	262	269	274	226	------	------
July	242	243	242	260	266	270	270	234	------	------
August	253	251	257	260	269	271	267	236	------	------
September	261	262	267	275	286	274	281	237	------	------
October	260	268	274	291	292	281	289	233	------	------
November	253	268	280	296	295	288	285	250	------	------
December	233	231	266	280	299	280	289	266	------	------
Average for year	241	249	258	272	271	278	274	224	------	------

Average weight of hogs for a series of years, by months, at leading cities—Cont'd.

OMAHA.

Month.	1902.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.	1893.
January	209	234	257	262	287	275	275	194	259	242
February	211	231	237	245	263	269	268	199	245	261
March	220	232	243	247	260	269	261	211	238	255
April	228	232	236	247	260	269	262	217	242	245
May	230	234	237	251	257	271	268	217	240	248
June	232	242	239	250	260	272	273	222	228	249
July	233	231	224	248	263	269	272	226	234	253
August	242	236	239	246	259	270	272	219	208	253
September	253	246	249	256	265	274	282	238	196	258
October	259	250	245	259	274	286	288	246	210	263
November	262	235	253	270	279	290	289	261	219	263
December	256	212	252	268	274	299	291	269	197	268
Average for year	236	235	243	254	266	276	275	227	227	253

Range of prices, per hundredweight, of cattle at Chicago and Omaha in 1902, by months, and annual range at Chicago since 1892.

CHICAGO.

Month.	Native steers (1,500-1,800 pounds).	Native steers (1,200-1,500 pounds).	Poor to choice cows and heifers.	Native stockers and feeders.	Texas and Western steers.
January	$5.75 to $7.75	$4.50 to $7.75	$3.50 to $5.60	$2.20 to $5.00	$3.45 to $6.25
February	5.65 to 7.35	4.50 to 7.25	3.50 to 5.75	2.25 to 5.15	4.00 to 6.00
March	6.00 to 7.35	5.20 to 7.40	3.75 to 6.25	2.35 to 5.50	4.50 to 6.65
April	6.65 to 7.50	5.70 to 7.50	4.70 to 6.75	2.35 to 5.75	5.15 to 6.50
May	6.60 to 7.70	5.50 to 7.65	4.40 to 7.00	2.50 to 5.60	3.25 to 6.85
June	6.85 to 8.35	5.75 to 8.50	3.80 to 7.10	2.35 to 6.00	3.25 to 7.65
July	7.60 to 8.85	5.30 to 8.75	3.75 to 8.25	2.25 to 5.75	3.50 to 6.90
August	7.35 to 9.00	4.40 to 9.00	3.50 to 8.00	2.40 to 5.80	3.15 to 7.15
September	7.00 to 8.85	4.75 to 8.75	3.60 to 7.00	2.25 to 5.55	3.25 to 7.25
October	6.50 to 8.75	4.50 to 8.65	3.35 to 7.00	1.90 to 5.20	2.55 to 7.40
November	5.10 to 7.40	3.70 to 7.40	3.50 to 5.60	2.00 to 4.90	2.85 to 6.50
December	4.25 to 14.50	3.60 to 8.75	3.60 to 5.90	2.00 to 4.85	3.75 to 5.20
Range:					
1902	4.25 to [a]14.50	3.60 to 9.00	3.35 to 8.25	1.90 to 6.00	2.55 to 7.65
1901	4.75 to 9.30	3.60 to 12.00	2.00 to 8.00	1.65 to 5.15	2.75 to 5.75
1900	4.70 to [b]15.50	3.90 to 11.00	1.75 to 6.00	2.10 to 5.25	3.00 to 5.90
1899	4.60 to 8.50	4.00 to 8.25	2.00 to 6.85	2.50 to 5.40	3.10 to 6.75
1898	4.10 to 6.25	3.80 to 6.15	2.00 to 5.40	2.50 to 5.40	3.15 to 5.40
1897	4.00 to 6.00	3.35 to 6.00	1.75 to 5.40	2.40 to 4.75	2.75 to 4.90
1896	3.40 to 6.50	2.90 to 6.25	1.75 to 4.40	2.20 to 4.10	2.10 to 5.50
1895	3.60 to 6.60	2.90 to 6.40	2.00 to 5.75	2.25 to 5.15	2.25 to 5.75
1894	3.00 to 6.60	2.90 to 6.00	1.75 to 4.40	2.00 to 4.15	2.50 to 5.00
1893	4.00 to 6.75	2.90 to 6.50	2.00 to 5.00	2.25 to 4.90	3.50 to 6.00
1892	3.75 to 7.00	2.86 to 6.35	1.85 to 4.00	2.00 to 4.10	1.50 to 5.25

[a] One load of Aberdeen-Angus steers, averaging 1,510 pounds, sold at $14.50.
[b] Fifteen Aberdeen-Angus steers, averaging 1,492 pounds, sold at $15.50.

OMAHA.

Month.	Native beeves.	Native cows.	Stockers and feeders.	Western steers.	Western cows.
January	$3.40 to $6.55	$2.10 to $4.90	$2.75 to $4.60	$3.50 to $4.60	$2.00 to $3.85
February	3.50 to 6.25	2.00 to 5.25	3.00 to 4.85	4.25 to 5.25	2.00 to 4.00
March	4.00 to 6.70	2.25 to 5.85	2.80 to 5.10	3.65 to 5.65	3.50 to 4.45
April	4.50 to 7.00	2.50 to 6.00	3.00 to 5.60	3.25 to 6.15	2.50 to 5.15
May	4.35 to 7.40	2.35 to 6.25	3.30 to 5.40	3.50 to 6.15	2.75 to 4.80
June	4.25 to 7.85	2.65 to 5.80	3.00 to 5.50	3.30 to 5.80	2.75 to 4.25
July	5.00 to 8.15	2.50 to 6.00	2.90 to 5.25	3.00 to 5.55	2.25 to 4.65
August	5.00 to 8.15	2.00 to 4.60	2.50 to 5.50	3.25 to 6.35	2.00 to 4.40
September	4.15 to 7.85	1.80 to 4.25	2.50 to 5.40	3.30 to 5.75	2.00 to 4.05
October	4.50 to 7.25	1.75 to 4.25	2.50 to 5.00	3.00 to 5.25	1.80 to 4.00
November	3.20 to 6.00	1.65 to 3.90	2.35 to 4.40	2.75 to 5.05	1.75 to 4.60
December	3.00 to 6.25	2.00 to 4.40	1.50 to 4.25	3.00 to 4.40	1.75 to 3.85

Range of prices, per hundredweight, of hogs at Chicago and Omaha in 1902, by months, and annual range at Chicago since 1892.

CHICAGO.

Month.	Heavy packing (250-500 pounds).	Mixed packing (200-250 pounds).	Light bacon (150-200 pounds).
January	$5.85 to $6.85	$5.75 to $6.65	$5.40 to $6.50
February	5.80 to 6.60	5.70 to 6.50	5.40 to 6.25
March	5.95 to 6.95	5.80 to 6.90	5.60 to 6.75
April	6.50 to 7.50	6.45 to 7.35	6.20 to 7.15
May	6.70 to 7.50	6.65 to 7.45	6.40 to 7.25
June	6.95 to 7.95	6.85 to 7.80	6.60 to 7.65
July	7.10 to 8.25	7.00 to 8.20	6.75 to 7.95
August	6.00 to 7.95	6.25 to 7.95	6.10 to 7.80
September	6.40 to 8.20	6.80 to 8.20	6.85 to 7.95
October	5.90 to 7.92½	6.10 to 7.90	6.00 to 7.70
November	5.75 to 6.95	5.75 to 6.90	5.65 to 6.75
December	5.70 to 7.15	5.65 to 6.85	5.40 to 6.75
Range:			
1902	5.70 to 8.25	5.65 to 8.20	5.40 to 7.95
1901	4.80 to 7.37½	4.85 to 7.30	4.75 to 7.20
1900	4.15 to 5.85	4.15 to 5.82½	4.10 to 5.75
1899	3.35 to 4.95	3.40 to 5.00	3.30 to 5.00
1898	3.10 to 4.80	3.10 to 4.70	3.10 to 4.65
1897	3.00 to 4.45	3.20 to 4.50	3.20 to 4.65
1896	2.40 to 4.45	2.75 to 4.45	2.80 to 4.45
1895	3.20 to 5.45	3.25 to 5.55	3.25 to 5.70
1894	3.90 to 6.75	3.90 to 6.55	3.50 to 6.45
1893	3.80 to 8.75	4.25 to 8.65	4.40 to 8.59
1892	3.70 to 7.90	3.60 to 6.85	3.60 to 6.85

OMAHA.

Month.	Heavy packing (275-500 pounds).	Mixed packing (230-270 pounds).	Light bacon (150-225 pounds).
January	$6.05 to $6.70	$5.40 to $6.20	$5.85 to $6.40
February	5.85 to 6.45	5.25 to 6.10	5.70 to 6.30
March	6.00 to 6.75	5.50 to 6.55	5.90 to 6.65
April	6.65 to 7.30	6.20 to 7.00	6.55 to 7.15
May	6.90 to 7.35	6.50 to 7.05	6.85 to 7.25
June	7.10 to 7.75	6.70 to 7.55	7.00 to 7.70
July	7.00 to 8.05	6.85 to 7.80	7.25 to 7.90
August	6.65 to 7.65	6.50 to 7.40	6.65 to 7.50
September	7.10 to 7.75	7.05 to 7.80	7.20 to 7.70
October	6.40 to 7.45	6.50 to 7.50	6.45 to 7.45
November	5.90 to 6.55	5.95 to 6.70	5.95 to 6.65
December	5.95 to 6.60	5.75 to 6.50	5.92½ to 6.52½

Range of prices, per hundredweight, of sheep at Chicago and Omaha in 1902, by months, and annual range at Chicago since 1892.

CHICAGO.

Month.	Native sheep (60–140 pounds).	Native yearlings and lambs.	Western sheep (70–140 pounds).	Western and Mexican lambs.
January	$2.00 to $5.00	$3.00 to $6.25	$2.50 to $4.75	$4.00 to $6.00
February	2.00 to 5.50	3.50 to 6.85	2.50 to 5.50	4.50 to 6.75
March	3.00 to 5.70	[a]3.00 to [a]6.85	3.00 to 5.75	[a]4.50 to [a]6.90
April	2.50 to 6.50	[a]3.50 to [a]6.85	3.15 to 6.30	[a]4.25 to [a]7.25
May	2.25 to 6.50	4.00 to 7.10	3.00 to 6.25	4.25 to 7.50
June	1.50 to 6.25	2.50 to 7.00	2.75 to 6.00	2.50 to 7.60
July	1.75 to 5.00	2.50 to 7.25	2.25 to 4.75	2.75 to 6.60
August	1.50 to 4.25	3.25 to 5.00	2.10 to 4.65	4.00 to 5.75
September	1.50 to 4.50	3.00 to 6.00	1.50 to 4.00	2.75 to 5.65
October	1.50 to 4.25	2.50 to 6.15	1.50 to 4.00	2.25 to 5.60
November	1.50 to 4.25	2.00 to 5.75	1.25 to 4.10	2.85 to 5.60
December	1.25 to 4.75	2.50 to 6.75	1.75 to 4.50	2.50 to 7.00
Range:				
1902	1.25 to 6.50	2.00 to 7.25	1.25 to 6.30	2.50 to 7.60
1901	1.40 to 5.25	2.00 to 6.25	1.50 to 5.25	2.75 to 5.90
1900	2.00 to 6.50	3.00 to 7.60	3.00 to 6.50	4.00 to 7.60
1899	2.25 to 5.65	3.50 to 7.45	2.50 to 5.55	4.00 to 7.00
1898	2.00 to 5.25	3.50 to 7.10	3.00 to 5.25	3.75 to 6.75
1897	1.25 to 5.25	3.00 to 6.40	2.15 to 5.35	3.50 to 7.25
1896	1.00 to 4.60	2.75 to 6.50	2.15 to 4.30	3.50 to 6.25
1895	1.25 to 5.50	2.25 to 6.35	2.50 to 5.35	3.00 to 6.00
1894	1.00 to 5.40	2.00 to 6.00	2.00 to 5.40	2.50 to 5.80
1893	1.50 to 6.25	2.25 to 7.55	2.50 to 6.45	2.25 to 6.75
1892	2.25 to 6.90	3.00 to 8.25	3.00 to 6.75	3.50 to 7.25

[a] Spring lambs sold during 1902 as high as $12, with many at $7 to $10.

OMAHA.

Month.	Native sheep.	Native lambs.	Western sheep.	Western lambs.
January	$4.00 to $5.15	$4.00 to $6.10	$3.75 to $4.75	$4.50 to $5.75
February	4.20 to 5.85	5.00 to 6.50	4.00 to 5.50	4.75 to 6.15
March	4.40 to 5.90	[a]5.50 to [a]6.70	4.00 to 5.25	[a]4.50 to [a]6.00
April	4.75 to 6.25	[a]5.75 to [a]6.90	4.50 to 5.65	[a]4.50 to [a]6.00
May	5.40 to 6.00	6.15 to 7.00	3.80 to 5.60	5.00 to 6.15
June	4.50 to 6.00	5.75 to 6.65	2.50 to 4.80	2.50 to 5.50
July	3.80 to 4.50	4.00 to 6.50	2.50 to 4.35	3.75 to 6.00
August	----------	----------	3.00 to 4.12½	2.70 to 6.00
September	2.00 to 3.40	3.50 to 5.40	2.50 to 4.00	4.00 to 5.10
October	3.00 to 4.10	3.25 to 5.75	2.00 to 3.80	3.40 to 4.90
November	3.40 to 4.25	3.40 to 5.25	2.75 to 3.80	3.00 to 5.00
December	3.50 to 4.75	3.50 to 5.50	2.50 to 3.35	3.00 to 4.25

[a] Spring lambs ranged from $7.50 to $11.

Range and average price of horses at Chicago and Omaha in 1902, by months, and annual average at Chicago since 1900.

CHICAGO.

Month.	Draft horses.	Carriage teams.	Drivers.	General use.	Bussers and trammers.	Saddlers.	Southern chunks.
January	$160	$420	$140	$115	$125	$150	$30
February	165	485	145	125	135	160	65
March	170	490	150	125	140	170	65
April	175	475	150	125	140	170	65
May	175	475	150	120	140	165	60
June	170	465	145	120	135	160	55
July	165	460	140	115	135	150	55
August	165	435	140	115	135	145	55
September	160	425	140	115	135	140	55
October	160	425	145	110	135	135	50
November	165	420	145	110	135	135	50
December	170	420	145	110	135	135	50
Average.							
1902	166	450	145	117	135	151	57
1901	157	400	137	102	121	147	52
1900	155	410	140	105	115	150	50

OMAHA.

Month.	Draft horses.	Carriage teams.	Drivers.	General use.	Chunks.	Western.	Southern.
January	$90 to $175	$200 to $350	$95 to $225	$55 to $85	$70 to $110	$10 to $50	$35 to $80
February	95 to 185	200 to 350	95 to 225	60 to 100	70 to 120	10 to 50	35 to 80
March	100 to 200	200 to 350	95 to 225	60 to 100	80 to 125	10 to 50	35 to 80
April	100 to 225	200 to 500	100 to 250	60 to 110	80 to 140	10 to 50	30 to 65
May	100 to 250	300 to 500	90 to 325	65 to 105	80 to 140	12½ to 60	25 to 60
June	90 to 200	300 to 450	90 to 325	60 to 90	75 to 120	12½ to 60	20 to 45
July	90 to 175	200 to 400	75 to 200	40 to 80	60 to 110	10 to 65	15 to 45
August	90 to 175	210 to 420	75 to 220	40 to 80	60 to 110	10 to 80	15 to 45
September	90 to 175	215 to 360	85 to 175	40 to 80	60 to 110	10 to 100	15 to 45
October	100 to 175	175 to 435	90 to 215	40 to 80	65 to 110	10 to 100	20 to 45
November	90 to 160	230 to 370	90 to 325	40 to 80	65 to 120	10 to 80	20 to 65
December	100 to 185	200 to 375	90 to 300	45 to 85	70 to 120	12½ to 60	20 to 70

WOOL PRODUCT OF THE UNITED STATES, 1902.

The following table is taken from the Bulletin of the National Association of Wool Manufacturers. The table published by that organization for the year 1901 was based upon the preliminary estimates of the census, and the efforts of the editorial office of this Bureau to revise the table in accordance with the final estimates of the census led to a serious error, in that lambs were accounted as shearing an average fleece of 6½ pounds. The result was a total for wool very much too large.

States and Territories.	Quality.	Number of sheep.	Average weight of fleece.	Per cent of shrinkage.	Wool, washed and unwashed.	Wool, scoured.	Average value per scoured pound, Oct. 1.		Total value.
							1901.	1902.	
			Pounds.		Pounds.	Pounds.	Cents.	Cents.	
Maine	Medium	239,972	6	40	1,439,832	863,899	35	38	$328,282
New Hampshire	¼ fine, ¾ medium	63,000	6½	55	409,500	184,275	42½	41	75,523
Vermont	do	160,000	6¾	56	1,080,000	475,200	42½	41	194,832
Massachusetts	Medium	33,000	6	48	198,000	102,960	38¾	38	39,125
Rhode Island	do	6,500	5½	42	35,750	20,735	35	38	7,879
Connecticut	do	34,000	5½	41	187,000	110,330	35	38	41,925
New York	⅓ fine, ⅔ medium	950,000	6	50	5,700,000	2,850,000	40	43	1,225,500
New Jersey	Medium	32,000	5	47	160,000	84,800	35	38	32,224
Pennsylvania	⅖ fine, ⅗ medium	960,000	6	52	5,760,000	2,764,800	41⅔	48	1,327,104
Delaware	Medium	6,500	6	50	39,000	19,500	35	38	7,410
Maryland	do	112,000	5	47	560,000	296,800	35	38	112,784
West Virginia	¾ fine, ¼ medium	544,400	5½	47	2,994,200	1,568,926	50	40	627,570
Kentucky	Medium	700,000	5	40	3,500,000	2,100,000	35	38	798,000
Ohio	⅖ fine, ⅗ medium	2,550,000	5½	52	14,025,000	6,732,000	48⅓	48	3,231,360
Michigan	⅓ fine, ⅔ medium	1,600,000	6½	52	10,400,000	4,992,000	45	43	2,146,560
Indiana	3/20 fine, 17/20 medium	960,000	6½	50	6,240,000	3,120,000	40	43	1,341,600
Illinois	⅓ fine, ⅔ medium	625,000	7	52	4,375,000	2,100,000	40	42	882,000
Wisconsin	1/10 fine, 9/10 medium	945,000	6½	50	6,147,500	3,073,750	40	40	1,229,500
Minnesota	⅕ fine, ⅘ medium	350,000	7	53	2,450,000	1,151,500	40	40	460,600
Iowa	½ fine, ½ medium	640,000	6½	50	4,160,000	2,080,000	40	44	915,200
Missouri	¼ fine, ¾ medium	595,000	6½	50	3,867,500	1,938,750	38¾	42	814,275
Virginia	Medium	380,000	4½	39	1,710,000	1,043,100	35	41	427,671

North Carolina	do	205,000	4¼	42	871,250	505,325	32	38	192,024
South Carolina	do	50,000	4¼	42	212,500	123,250	32	38	42,835
Georgia	do	250,000	4	40	1,000,000	600,000	32	38	228,000
Florida	do	100,000	4	42	400,000	232,000	32	38	88,160
Alabama	do	225,000	4	40	900,000	540,000	32	38	205,200
Mississippi	do	230,000	4½	42	1,035,000	600,300	32	38	228,114
Louisiana	do	155,000	4	45	620,000	341,000	32	38	129,580
Arkansas	do	160,000	4½	42	720,000	417,600	32	38	158,688
Tennessee	do	300,000	4¼	40	1,275,000	765,000	32	30	229,500
Kansas	Fine, fine medium, and medium	160,000	8	65	1,280,000	448,000	40	44	197,120
Nebraska	do	330,000	8	63	2,640,000	976,800	40	44	429,792
South Dakota	do	507,000	6½	58	3,295,500	1,911,100	38	47	898,217
North Dakota	do	450,000	6½	60	2,925,000	1,170,000	38	47	549,900
Montana	do	5,081,000	7	63	35,567,000	13,159,790	43	47	6,185,101
Wyoming	do	4,614,750	7½	65	34,610,000	12,113,500	43	47	5,693,345
Idaho	do	2,500,000	7¼	66	18,125,000	6,162,500	40	47	2,896,375
Washington	do	560,000	8½	74	4,760,000	1,217,600	40	47	572,272
Oregon	do	2,000,000	8½	70	17,000,000	5,100,000	42	50	2,550,000
California	⅓ fall, ⅔ spring	1,725,000	7¼	68	12,506,000	4,001,920	40	48	1,920,922
Nevada	Fine, fine medium, and medium	568,000	7¼	70	4,118,000	1,235,400	43	50	617,700
Utah	do	2,600,000	6½	65	16,900,000	5,915,000	40	47	2,780,050
Colorado	do	1,400,000	6½	68	9,100,000	2,912,000	38	42	1,223,040
Arizona	do	669,000	7½	67	5,017,500	1,655,775	40	47	778,214
New Mexico	do	3,360,000	4¼	52	14,280,000	6,854,400	38	42	2,878,848
Texas	¼ fall, ¾ spring	1,440,000	6½	68	9,360,000	2,995,200	43⅜	50	1,497,600
Oklahoma and Indian Territory	Fine and fine medium	60,000	6½	63	390,000	144,300	40	42	60,606
Total fleece wool		42,184,122	6½	60	274,341,032	109,771,085	41.1	45.1	49,498,127
Total pulled wool				33	42,000,000	28,140,000	36.7	39.7	11,181,000
Total product					316,341,032	137,912,085			60,679,127

THE TUBERCULIN TEST OF CATTLE IN GREAT BRITAIN.

Results of tests made by the Bureau of Animal Industry on cattle offered for exportation to the United States.

By D. E. SALMON, D. V. M.,
Chief of Bureau of Animal Industry.

The testing with tuberculin of cattle offered for importation into the United States in order to exclude those affected with tuberculosis, has been the subject of careful and earnest consideration by this Bureau. The act of Congress of August 30, 1890, prohibits the importation of animals "which are diseased or infected with any disease, or which shall have been exposed to such infection within sixty days next before their exportation;" and in carrying out this law the tuberculin test has been adopted as the most accurate and reliable means of determining whether cattle are diseased with tuberculosis.

Regulations were issued under date of December 28, 1899, requiring that "all cattle over six months old imported into the United States after March 1, 1900, which are subject to quarantine and except as otherwise provided, shall be tested with tuberculin after their arrival at quarantine." It was found that while this provision had a beneficial effect in keeping out tuberculous animals, especially those in which the disease could not be detected by ordinary physical examination, it resulted in some cases in hardship and loss to importers. Even where importers took the precaution of having cattle tested abroad unofficially before purchase and importation, some of the animals which were certified to have passed such a test reacted to the official test in the United States quarantine station and were condemned.

To protect the importers from such losses it was decided to station an inspector in Great Britain, where most of our purebred stock is purchased, to make the official tests before the shipment of the cattle, and in the latter part of the year 1900 Dr. Tooie A. Geddes was sent to that country to perform this work. The regulations were amended so as to provide that "all cattle over six months old imported from Great Britain directly into the United States after December 1, 1900, which are subject to quarantine, and except as otherwise provided, shall be tested with tuberculin by an inspector of this Department stationed in that country or after arrival at the animal quarantine station at the port of entry." The Canadian government also detailed an inspector to make tests in Great Britain, and an arrangement was made between the United States and Canada for each Government to accept the certificates of the other's inspector.

This testing of cattle in Great Britain by the Bureau has now been

in progress for two years, and the results are shown in the accompanying tables. A number of animals tested in the Channel Islands and in Ireland have been included.

Statement of results of tuberculin tests of cattle in Great Britain and Ireland and the Channel Islands, by the U. S. Department of Agriculture.

TESTED IN 1901.

Breed.	Number tested.	Number passed.	Number rejected.	Percentage rejected.
Aberdeen-Angus	100	69	31	31.00
Ayrshire	6	6	0	0.00
Galloway	1	1	0	0.00
Guernsey (on Island)	28	28	0	0.00
Guernsey (in Great Britain)	42	37	5	11.90
Hereford	239	231	8	3.35
Jersey (on Island)	158	157	[a] 1	0.63
Red Polled	36	34	2	5.56
Shorthorn	110	83	27	24.55
Total	720	646	74	10.28

TESTED IN 1902.

Breed.	Number tested.	Number passed.	Number rejected.	Percentage rejected.
Aberdeen-Angus	262	189	73	27.86
Ayrshire	27	19	8	29.63
Dexter Kerry	15	15	0	0.00
Galloway	35	29	6	17.14
Guernsey (on island)	25	25	0	0.00
Guernsey (in Great Britain)	15	9	6	40.00
Hereford	189	180	9	4.71
Highland [b]	19	16	3	15.79
Jersey (on island)	166	166	0	0.00
Jersey (in Great Britain)	42	19	23	54.76
Red Polled	21	19	2	9.52
Shorthorn	118	92	26	22.03
Sussex	1	1	0	0.00
Total	925	779	156	16.68

TESTS OF TWO YEARS—1901 AND 1902.

Breed.	Number tested.	Number passed.	Number rejected.	Percentage rejected.
Aberdeen-Angus	362	258	104	28.73
Ayrshire	33	25	8	24.24
Dexter Kerry	15	15	0	0.00
Galloway	36	30	6	16.67
Guernsey (on island)	53	53	0	0.00
Guernsey (in Great Britain)	57	46	11	19.30
Hereford	428	411	17	3.97
Highland	19	16	3	15.79
Jersey (on island)	324	323	1	0.31
Jersey (in Great Britain)	42	19	23	54.76
Red Polled	57	53	4	7.02
Shorthorn	228	175	53	23.25
Sussex	1	1	0	0.00
Total	1,655	1,425	230	13.90

[a] This being the only animal showing a reaction among a large number tested on the Island of Jersey, there may be some doubt as to whether the elevation of temperature was caused by tuberculosis.

[b] Ten of these animals were not tested until after arrival at quarantine station in the United States, having been shipped from Great Britain without test.

The cattle on the islands of Guernsey and Jersey are shown to be practically free from tuberculosis, and the regulations now permit cattle to be imported into the United States directly from those islands without being tested with tuberculin. Eliminating from the tables the tests of cattle on those islands, the proportions of reactions among the tests made in Great Britain and Ireland are found to be as follows: In 1901, 13.67 per cent; in 1902, 20.97 per cent; for both years, 17.92 per cent. Although the total percentage of reactions in 1901 is considerably less than that for 1902, this difference is more apparent than real, and is due to the fact that during the former year there was a much larger proportion of animals tested belonging to the breeds which gave low percentages of reactions. This condition naturally lowered the general average for that year and probably made it much less than it would have been if the number of animals tested from each of the leading breeds had been more nearly equal.

The results of the tests by Dr. Geddes are borne out in a remarkable manner by the work of the Canadian inspector in Great Britain, Dr. A. G. Hopkins. In his report to his government for the year ended October 31, 1902, Dr. Hopkins says:[a]

> The number of cattle tested by me was 571 head, all Shorthorns, except for a few Galloways and Aberdeen-Angus. Owing to the great demand for Shorthorns and to the severe culling out of some herds, this and previous seasons, a number of inferior animals have been shipped across the Atlantic.
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> * * * * * * *
>
> The percentage of reactions was 23; this season comparatively few cows were tested, buyers profiting by former experience, and thus bought only two-year-olds and under to be submitted to the test. As far as I can gather from the tests made, the percentage of cattle affected increases with age; more yearlings are affected than calves and more two-year-olds than yearlings.

Dr. Hopkins thus gives his percentage of reactions as 23, nearly all the animals tested being Shorthorns, while the percentage of Shorthorns reacting in the tests of Dr. Geddes for the two years is $23\frac{1}{4}$.

It is interesting to note the contrast which appears in the foregoing tables between the results of the tests of the Jersey and Guernsey breeds on their native islands and in Great Britain. While these breeds are free from tuberculosis on the Channel Islands, where they do not come in contact with diseased animals, it is seen that when taken to Great Britain and exposed to infection they very readily contract the disease.

The work of the Bureau during the first season made it apparent that some of the British herds were very badly diseased, and as the law above quoted prohibits the importation into the United States of exposed animals as well as those which are diseased, it seemed that when a herd was very badly affected all the animals in it must be

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[a] Report of the minister of agriculture for the Dominion of Canada for the year ended October 31, 1902, p. 134.

regarded as exposed and therefore excluded from importation, whether all of them were actually diseased or not at the time of applying the test. There was also evidence sufficient to cause a strong suspicion that in some instances fraudulent means were being used for the purpose of defeating the test in diseased herds, such as injecting tuberculin in advance of the official test so as to prevent a reaction, or administering drugs to prevent a rise in temperature. In view of these circumstances the inspector was instructed early in 1902 that whenever a herd was found to be so badly diseased that 20 per cent or more of the animals tested gave reactions no further tests should be made by him in such herd until proper steps had been taken by the owner for the eradication of the disease. This policy excluded from future tests some of the worst affected herds, and consequently the percentage of reactions during the second year, large as it is, is undoubtedly less than it would otherwise have been.

The results of these tests confirm what has previously been known and stated concerning the alarming prevalence of tuberculosis among purebred herds in Great Britain and the danger of contaminating our finest American herds by the importation of tuberculous breeding stock. They show the great importance and the real necessity of the measures enforced by the United States Government. They show that within two years this policy has excluded from our herds 229 tuberculous animals from the purebred herds of Great Britain and Ireland alone, which it was desired to import into the United States, and which without the tuberculin test would undoubtedly have been introduced into some of our best herds.

The opposition to the Department regulations requiring the tuberculin test for imported cattle has come principally from comparatively few persons who are interested in the importation and sale of breeding stock. Some have even been dissatisfied because they were not permitted to import animals which had reacted to the test or which came from herds known to be badly diseased. It is incredible that these men desired to introduce such cattle into their own herds. Their desire was evidently to purchase them cheaply in Great Britain and import them into the United States for sale at a profit. The facts shown by these tables, it is believed, are sufficient to demonstrate to any fair-minded person that the regulations are not unreasonable or unduly severe, but are necessary for the protection of the herds of the United States.

RULES AND REGULATIONS OF THE BUREAU OF ANIMAL INDUSTRY ISSUED IN 1902.

[B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 10, 1902.

To managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In accordance with section 7 of the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the importation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and of the act of Congress approved March 2, 1901, making appropriation for the Department of Agriculture for the fiscal year ending June 30, 1902, you are hereby notified that a contagious and infectious disease known as splenetic, Southern, or Texas fever exists among cattle in the following-described area:

1. All that country lying south, or below, a line beginning at the northwest corner of the State of California; thence east, south, and southeasterly along the boundary line of said State of California to the southeastern corner of said State; thence southerly along the western boundary line of Arizona to the southwest corner of Arizona; thence along the southern boundary lines of Arizona and New Mexico to the southeastern corner of New Mexico; thence northerly along the eastern boundary of New Mexico to the southern line of the State of Colorado; thence along the southern boundary lines of Colorado and Kansas to the southeastern corner of Kansas; thence southerly along the western boundary line of Missouri to the southwestern corner of Missouri; thence easterly along the southern boundary line of Missouri to the western boundary line of Dunklin County; thence southerly along the said western boundary to the southwestern corner of Dunklin County; thence easterly along the southern boundary line of Missouri to the Mississippi River; thence northerly along the Mississippi River to the northern boundary line of Tennessee at the northwest corner of Lake County; thence easterly along said boundary line to the northeast corner of Henry County; thence in a northerly direction along the boundary of Tennessee to the northwest corner of Stewart County; thence in an easterly direction along the northern boundary of Tennessee to the southwestern corner of Virginia; thence northeasterly along the western boundary line of Virginia to the northernmost point of Virginia; thence southerly along the eastern boundary line of Virginia to the northeast corner of Virginia, where it joins the southeastern corner of Maryland, at the Atlantic Ocean.

2. Whenever any State or Territory located above or below said quarantine line, as above designated, shall duly establish a different quarantine line, and obtain the necessary legislation to enforce said last-mentioned line strictly and completely within the boundaries of said State or Territory, and said last above-

mentioned line and the measures taken to enforce it, are satisfactory to the Secretary of Agriculture, he may, by a special order, temporarily adopt said State or Territorial line.

Said adoption will apply only to that portion of said line specified, and may cease at any time the Secretary may deem it best for the interests involved, and in no instance shall said modification exist longer than the period specified in said special order; and at the expiration of such time, said quarantine line shall revert without further order to the line first above described.

Whenever any State or Territory shall establish a quarantine line, for above purposes, differently located from the above-described line, and shall obtain by legislation the necessary laws to enforce the same completely and strictly, and shall desire a modification of the Federal quarantine line to agree with such State or Territorial line, the proper authorities of such State or Territory shall forward to the Secretary of Agriculture a true map or description of such line and a copy of the laws for enforcement of same, duly authenticated and certified.

3. From the 1st day of February, 1902, no cattle are to be transported from said area south, or below, said Federal quarantine line above described to any portion of the United States above—north, east, or west of—the above-described line, except as hereinafter provided.

4. Cattle from said area may be transported by rail or boat for immediate slaughter, and when so transported the following regulations must be observed:

(*a*) When any cattle in course of transportation from said area are unloaded above—north, east, or west of—this line to be fed or watered, or for other purposes, said cattle shall be placed in pens or yards set apart for infected cattle, and no other cattle shall be admitted thereto.

(*b*) On unloading said cattle at their points of destination, chutes, alleyways, and pens, sufficiently isolated, shall be set apart to receive them, and no other cattle shall be admitted to said chutes, pens, and alleyways; and the regulations relating to the movement of cattle from said area, prescribed by the cattle sanitary officers of the State where unloaded, shall be carefully observed. The cars or boats that have carried said stock shall be cleansed and disinfected as soon as possible after unloading and before they are again used to transport, store, or shelter animals or merchandise.

(*c*) All cars carrying cattle from said area shall bear on both sides printed placards, the letters of which shall be plain and not less than 1½ inches in height, to be affixed by the railroad company hauling the same, stating that said cars contain Southern cattle; and each of the waybills, conductor's manifests, and bills of lading of said shipments by cars or boats shall have a note plainly written or stamped upon its face with a similar statement. Whenever any cattle have come from said area and shall be reshipped from any point at which they have been unloaded to other points of destination, the cars carrying said animals shall bear on both sides similar placards with like statements, and the waybills, conductor's manifests, or bills of lading be so stamped. At whatever point these cattle are unloaded they must be placed in separate pens, to which no other cattle shall be admitted.

(*d*) No boat having on board cattle from said district shall receive on board cattle from outside of said district. Cattle from said district shall not be received on board when destined to points outside of said district where proper facilities have not been provided for transferring the said cattle from the landing to the stock yards and slaughterhouses without passing over public highways, unless permission for such passing is first obtained from the local authorities.

(*e*) The cars and boats used to transport such animals, the chutes, alleyways, and pens used during transportation and at points of destination shall be disinfected in the following manner:

Remove all litter and manure. This litter and manure may be disinfected by mixing it with lime or saturating it with a 5 per cent solution of 100 per cent carbolic acid, or, if not disinfected, it may be stored where no cattle can come in contact with it during the period from February 1 to November 15 of each year.

Wash the cars and the feeding and watering troughs with water until clean.

Saturate the entire interior surface of the cars and the fencing, troughs, and chutes of the pens with a mixture made of 1½ pounds of lime and one-quarter pound of 100 per cent straw-colored carbolic acid to each gallon of water; or a solution made by dissolving 4 ounces of chloride of lime to each gallon of water may be used; or disinfect the cars with a jet of steam under a pressure of not less than 50 pounds to the square inch.

5. Cattle from the Republic of Mexico may be admitted into the United States, after inspection according to law, as follows:

Cattle free from splenetic or Texas fever, and from contact therewith during the six months preceding such inspection, and which have been grazed in a locality free from infection of such fever, may be admitted into any part of the United States. If destined to points in the noninfected area, a special permit must be obtained from an inspector of the Bureau of Animal Industry, said permit being issued according to the regulations of said Bureau. The cattle for which said permit is issued must not be driven through the infected area, nor be unloaded in any part thereof except at such a point as may be duly designated by an order issued by this Department. If shipped in infected cars or unloaded in the infected area, except as above stated, they will be subject to the regulations concerning infectious cattle.

6. Notice is hereby given that cattle infested with the *Boophilus annulatus* (*B. bovis*), or Southern cattle tick, disseminate the contagion of splenetic, Southern, or Texas fever; therefore cattle originating outside of the district described by this order or amendments thereof, and which are infested with the *Boophilus annulatus* ticks, shall be considered as infectious cattle and shall be subject to the rules and regulations governing the movement of Southern cattle.

7. Stock-yard companies receiving cattle infested with said ticks shall place such cattle in the pens set aside for the use of of Southern cattle, and transportation companies are required to clean and disinfect all cars and boats which have contained the same, according to the requirements of this Department.

8. Inspectors are instructed to see that disinfection is properly done, and to report instances of improper disinfection. It is expected that transportation and stock-yard companies will promptly put into operation the above methods.

All prior orders conflicting herewith are hereby revoked.

JAMES WILSON, *Secretary*.

[AMENDMENT NO. 1 TO B. A. I. ORDER 93.]

Special Order Modifying Quarantine Line for the State of California—1902.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 11, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of California has agreed to establish and cooperate in the enforcement of a quarantine line located as follows:

"Beginning on the Pacific coast where the northern boundary line of Monterey County connects with the Pacific Ocean, thence easterly and southerly along the northern and eastern boundary line of Monterey County to its junction with the western boundary of Fresno County; thence northerly along the western

boundary of Fresno County to the western corner thereof; thence northerly, easterly, and southerly along the western, northern, and eastern boundary line of Merced County to the southeast corner thereof; thence northeasterly along the northern boundary of Madera County to the northeast corner thereof; thence southerly and easterly along the eastern boundary lines of Madera, Fresno, and Tulare counties to the southeast corner of Tulare County; thence easterly along the southern boundary line of Inyo County to its intersection with the eastern boundary line of the State of California."

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of California to enforce said quarantine line, therefore the above quarantine line is adopted for the State of California by this Department for the period beginning on February 1, 1902, and ending January 31, 1903, in lieu of the quarantine line described in the order of January 10, 1902, for said area, unless otherwise ordered.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 2 TO B. A. I. ORDER NO. 93.]

Special Order Modifying Quarantine Line for the State of Texas—1902.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 11, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of Texas has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning at the intersection of the southern boundary of New Mexico with the international boundary line at the Rio Grande River, thence southeasterly along the said international boundary line to the southwest corner of the county of Pecos; thence following the western boundary of Pecos County to the southeast corner of Reeves County; thence following the boundary line between the counties of Pecos and Reeves to the Pecos River; thence southeasterly, following the Pecos River, to the northwest corner of Crockett County; thence east along the northern boundary of Crockett and Schleicher counties to the southeastern corner of Irion County; thence north along the eastern boundary of Irion County to the northeast corner of said county; thence north to the southern boundary of Coke County: thence west to the southwest corner of Coke County; thence north along the western boundary of Coke County to the southern boundary of Mitchell County; thence east to the southeastern corner of Mitchell County; thence north along the eastern boundary of Mitchell County to the northeast corner of said county; thence east along the southern boundaries of Fisher and Jones counties to the southeast corner of Jones County; thence north along the eastern boundary of Jones County to the northeast corner of said county; thence east along the southern boundary of Haskell County to the southeast corner of said county; thence north along the western boundary lines of Throckmorton and Baylor counties to the northwest corner of Baylor County; thence east along the southern boundary of Wilbarger County to the southeast corner of said county; thence north along the eastern boundary of Wilbarger County to the Red River; thence continuing in a northwesterly direction along the course of said river and the northern boundary of Texas to the southeast corner of Greer County, Oklahoma Territory."

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of Texas to enforce said quarantine line, therefore the above quarantine line is adopted for the State

of Texas by this Department for the period beginning on February 1, 1902, and ending January 31, 1903, in lieu of the quarantine line described in the order of January 10, 1902, for said area, unless otherwise ordered.

It is further ordered, That during the continuance of the above line no cattle originating in the quarantined area as described in B. A. I. Order No. 93, as modified, shall be moved or allowed to move into the counties of Baylor and Throckmorton and that portion of the county of Pecos lying north and west of the line described as follows: Beginning at the west line of Pecos County at the point where the roadbed of the G. H. and S. A. Railroad crosses said line; thence in an easterly direction with the center of said roadbed to a point on section No. 36, Block A2, G. H. and S. A. Railroad Company; thence north with the pasture fence running in a northerly direction through the eastern part of sections Nos. 13 and 12 of said Block A2 and across section No. 1 G. C. and S. F. Railroad Company; thence continuing north with said pasture fence through the eastern part of sections Nos. 16, 17, 46, 47, 76, 77, 106, 107, 136, 137, 142, 143, and 194, Block D, M. K. and T. E. Railroad Company; thence continuing in a northerly direction to a point on the north line of section No. 6, Block 160, G. C. and S. F. Railroad Company, same being corner of pasture fence; thence east with the north line of sections Nos. 6, 9, 10, 11, 12, 15, 16, Block 160, G. C. and S. F. Railroad Company, to the northeast corner of said section No. 16, same being corner of pasture fence; thence in a northerly direction with the east boundary line of sections Nos. 22, 21, 20, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, Block 1, C. C. S. D. and R. G. N. G. Railroad Company, to the northeast corner of said section 32; thence west with the north boundary line of sections Nos. 32 and 33, same block, to the northwest corner of section No. 33, block 1, C. C. S. D. and R. G. N. G. Railroad Company, corner of fence; thence north with the east boundary line of sections Nos. 1, 12, 13, 24, 25, 36, 37, 48, 49, 60, 61, and 72, Block 2, C. C. S. D. and R. G. N. G. Railroad Company, to the northeast corner of said section No. 72; thence in an easterly direction with the pasture fence to the southeast corner of section No. 9, patented to James E. Evans; thence north with the east line of said section No. 9 to the northwest corner of section No. 100, Block A2, T. C. Railroad Company; thence east with north boundary line of said sections Nos. 100 and 89, same block, to the northeast corner of said section No. 89, Block A2, T. C. Railroad Company; thence north with the east boundary line of sections Nos. 90, 91, 92, and 93 to the southeast corner of section No. 94, Block A2, T. C. Railroad Company; thence northwest diagonally across section No. 94 to the northwest corner of said section; thence continuing in a northwesterly direction diagonally across sections Nos. 14, 18, and 28 to the northeast corner of section No. 29, Block C4, G. C. and S. F. Railroad Company; thence west with the north boundary line of said section No. 29 to the northwest corner of said section; thence northwest diagonally across section No. 1, T. C. Railroad Company, section No. 97, Block No. 194, G. C. and S. F. Railroad Company, to the northeast corner of said section No. 96; thence in a northerly direction across section No. 94 to a point on its north boundary line 600 varas west of its northeast corner; thence continuing north through sections Nos. 93, 90, 89, 86, 85, and 58, Block 194, G. C. and S. F. Railroad Company, to a point on the north boundary line of said section No. 58; thence northwesterly with the pasture fence through section No. 59 to the northeast corner of section No. 82 and the southeast corner of section No. 81, same block; thence continuing northwesterly to section No. 17, H. and G. N. Railroad Company; thence north with the east line of said section 17 to the Pecos River; thence northwesterly with said Pecos River to the northwest corner of Crockett County.

And it is further ordered, That no cattle shall be moved or allowed to move from the counties of Childress, Cottle, Hardeman, Foard, Wilbarger, King, Knox, Haskell, Stonewall, Jones, Fisher, Scurry, Garza, Borden, Howard, Mitchell,

Glasscock, Sterling, Irion, West Tom Green, Upton, Crane, Throckmorton, and Baylor, and that portion of the county of Pecos as described above, to any of that territory in the State of Texas lying west and north of said counties, except after having been inspected and found free of infection by duly authorized inspectors of this Department or of the State of Texas, and upon written permission by such officer. No cattle from said counties shall be moved or allowed to move to any State or Territory outside of the quarantined district (except as provided for immediate slaughter) unless they have been duly inspected and passed, and permit issued by inspectors of this Department, nor until permission has been obtained from the proper officials of the State or Territory to which said cattle are destined.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 3 TO B. A. I. ORDER NO. 93.]

Special Order Modifying Quarantine Line for the Territory of Oklahoma—1902.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 11, 1902.

In accordance with the regulations concerning cattle transportion issued by this Department, the Territory of Oklahoma has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning on the Red River at the southeastern corner of the county of Greer; thence northerly following the course of the North Fork of the Red River to its intersection with the southern boundary line of Roger Mills County along the western boundary lines of the Apache, Comanche, and Kiowa Indian reservations; thence east along the southern boundary lines of Roger Mills and Washita counties to the intersection with the boundary line of the Wichita Indian reservation on the Washita River; thence north along the western boundary line of said reservation to its northwest corner at its intersection with the Canadian River in the County of G; thence in a southeasterly direction along the course of said river and the northern boundary of the Wichita Indian Reservation to the northeast corner of said reservation; thence easterly along the southern boundary of Canadian County to the southeast corner of said county; thence north along eastern boundary line of Canadian County to the northwest corner of Cleveland County; thence east along the northern line of Cleveland County to the middle of the right of way of the Atchison, Topeka and Santa Fe Railway; thence northerly following the middle of said right of way through Oklahoma, Logan, Noble, and Payne counties, and the Otoe, Missouri, and Ponca Indian reservations to the northern boundary of the Ponca Indian Reservation; thence east along the northern boundary of the Ponca Indian Reservation to the Arkansas River; thence in a northerly direction following the course of the said river to its intersection with the thirty-seventh parallel of north latitude at the southern boundary line of Kansas."

And whereas said quarantine line as above set forth is satisfactory to this Department, and legislation has been enacted by the Territory of Oklahoma to enforce said quarantine line, therefore the above quarantine line is adopted for the Territory of Oklahoma by this Department for the period beginning on February 1, 1902, and ending January 31, 1903, in lieu of the quarantine line described in the order of January 10, 1902, for said area, unless otherwise ordered.

It is further ordered, That during the continuance of the above line no cattle shall be moved or allowed to move from the county of Greer to any of that part of the Territory of Oklahoma lying west and north of said line, except after

having been inspected and found free of infection by duly authorized inspectors of this Department or of the Territory of Oklahoma, and upon written permission by such officer. No cattle from said county shall be moved or allowed to move to any State or Territory outside of the quarantined district (except as provided for immediate slaughter) unless they have been duly inspected and passed, and permit issued by inspectors of this Department, nor until permission has been obtained from the proper officials of the State or Territory to which destined.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 4 TO B. A. I. ORDER NO. 93.]

Special Order Modifying Quarantine Line for the State of Tennessee—1902.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 11, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of Tennessee has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning on the Mississippi River at the southeast corner of the State of Missouri at the western boundary of Tennessee; thence southerly along the western boundaries of the counties of Dyer and Lauderdale; thence following the main channel of the Mississippi River (leaving Island No. 37 to the north and west) to the northwestern corner of Shelby County on the Mississippi River; thence easterly along the northern boundary lines of Shelby and Fayette counties to the southwestern corner of Haywood County; thence northerly and easterly along the western and northern boundary lines of Haywood County to the northeastern corner of said county; thence easterly along the northern boundary lines of Madison and Henderson counties to the intersection of the N. C. and St. L. Railway with the northern boundary of Henderson County; thence northerly following the middle of the roadbed of said railway through Carroll County to Hollow Rock Junction in said county; thence easterly along the middle of the roadbed of said railway through Carroll and Benton counties to the intersection of said N. C. and St. L. Railway with the Tennessee River at the eastern boundary of Benton County; thence south along the eastern boundaries of Benton and Decatur counties to the northwest corner of Wayne County; thence easterly along the northern boundary lines of Wayne and Lawrence counties to the northwestern corner of Lawrence County; thence south along the eastern boundary of Lawrence County to the southeast corner thereof; thence east along the southern boundary of Giles County to the southwest corner of Lincoln County; thence north along the western line of Lincoln County to the Elk River; thence easterly along said river to the eastern boundary of Lincoln County; thence northerly and easterly along the western and northern boundaries of Moore County to the northeast corner of Moore County; thence north along the western boundary lines of Coffee and Cannon counties to the northwest corner of Cannon County; thence easterly along the northern boundaries of Cannon, Warren, Van Buren, Bledsoe, and Rhea counties to the northern corner of Rhea County; thence southerly along the eastern boundary lines of Rhea and James counties to the northwest corner of Bradley County; thence northerly and southeasterly along the northern boundary lines of Bradley and Polk counties to the northeast corner of Polk County; thence south along the eastern boundary line of Polk County to the southeast corner thereof at the southwestern corner of North Carolina."

That portion of the quarantine line for the State of Virginia described in the

order of January 11, 1902 (amendment No. 7 to B. A. I. Order No. 93), beginning at the southwestern corner of Virginia (Lee County) and extending east along the southern boundary line of Virginia to the southeastern corner of Washington County is hereby suspended during the enforcement of the above line for the State of Tennessee.

And whereas said quarantine line as above set forth is satisfactory to this Department, and legislation has been enacted by the State of Tennessee to enforce said quarantine line, therefore the above line is adopted for the State of Tennessee by this Department for the period beginning on February 1, 1902, and ending January 31, 1903, in lieu of the quarantine line described in the order of January 10, 1902, for said area, unless otherwise ordered.

JAMES WILSON, *Secretary.*

[AMENDMENT No. 5 TO B. A. I. ORDER No. 93.]

Special Order Modifying Quarantine Line for the State of Georgia—1902.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 11, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of Georgia has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning at the intersection of the western boundary line of Union County with the boundary line between the States of Georgia and North Carolina, thence southerly along the western boundary of Union County to the southwest corner thereof; thence northeasterly along the southern boundary line of Union County to its intersection with the boundary line of Towns County; thence southerly, easterly, and northerly along the boundary line of Towns County to the western corner of Rabun County near the mouth of Wild Cat Creek; thence in an easterly direction through Charlie Mountain, Glassie Mountain, and Tiger Mountain and along the ridge following Stekoa Creek to Dick Creek; thence northerly through Rainy Mountain, Hogback Ridge, Pinnacle, Raven Knob, Rock Mountain, and Rabun Bald to the State boundary between Georgia and North Carolina."

That portion of the quarantine line for the State of North Carolina, described in the order of January 11, 1902 (amendment No. 6 to B. A. I. Order No. 93), beginning at the intersection of the northwest corner of Union County, Ga., with the State line, extending east along the southern boundary line of North Carolina to the intersection with the ridge extending from Rabun Bald to the State line, is hereby suspended during the enforcement of the above line for the State of Georgia.

And whereas said quarantine line as above set forth is satisfactory to this Department and legislation has been enacted by the State of Georgia to enforce said quarantine line, therefore the above quarantine line is adopted for the State of Georgia by this Department for the period beginning on February 1, 1902, and ending January 31, 1903, in lieu of the quarantine line described in the order of January, 10, 1902, for said area, unless otherwise ordered.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 6 TO B. A. I. ORDER NO. 93.]

Special Order Modifying Quarantine Line for the State of North Carolina—1902.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 11, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of North Carolina has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning at the southwest corner of the county of Cherokee; thence east along the southern boundary lines of the counties of Cherokee, Clay, Macon, Jackson, Transylvania, and Henderson to the southeast corner of the county of Henderson; thence northerly along the eastern boundary line of Henderson County to the northeast corner thereof; thence westerly to the eastern boundary line of Buncombe County; thence northerly along the eastern boundary line of Buncombe County to the southern boundary line of Yancey County; thence northeasterly along the southern boundary line of Yancey County to the southern portion of Mitchell County; thence northeasterly along the southern and eastern boundary line of Mitchell County to the southern boundary line of Watauga County; thence easterly along the southern boundary line of Watauga County to the western boundary line of Wilkes County; thence following the western and northern boundary line of Wilkes County to the western portion of Surry County; thence northeasterly along the eastern boundary line of Alleghany County to its intersection with the northern boundary line of the State of North Carolina."

That portion of the quarantine line for the State of Virginia, described in the order of January 11, 1902 (amendment No. 7 to B. A. I. Order No. 93), beginning at the southwestern corner of Grayson County and extending east along the southern boundary line of Virginia to the southeastern corner of said county, is hereby suspended during the enforcement of the above line for the State of North Carolina.

And whereas said quarantine line as above set forth is satisfactory to this Department and legislation has been enacted by the State of North Carolina to enforce said quarantine line, therefore the above quarantine line is adopted for the State of North Carolina by this Department for the period beginning on February 1, 1902, and ending January 31, 1903, in lieu of the quarantine line described in the order of January 10, 1902, for said area, unless otherwise ordered.

It is further ordered, That, during the continuance of the above line, no cattle originating in the quarantine district, as described in B. A. I. Order No. 93, as modified, shall be moved or allowed to move into the counties of Surry, Wilkes, Caldwell, Burke, and McDowell.

And it is further ordered, That no cattle shall be moved or allowed to move from the counties of Surry, Wilkes, Caldwell, Burke, and McDowell, and that portion of Henderson County lying south and east of a line beginning at its southwestern corner, following its western boundary to the French Broad River, thence along the course of said river to the northern boundary line of said county, and thence easterly along the northern boundary to the northeastern corner of said county to any of that territory in the State of North Carolina lying west and north of said counties, except after having been inspected and found free of infection by duly authorized inspectors of this Department or of the State of North Carolina, and upon written permission by such officer. No cattle from said counties shall be moved or allowed to move to any State or Territory outside of the quarantined district (except as provided for immediate slaughter), unless they

have been duly inspected and passed and permit issued by inspectors of this Department, nor until permission has been obtained from the proper officials of the State or Territory to which destined.

JAMES WILSON, *Secretary*.

[AMENDMENT NO. 7 TO B. A. I. ORDER NO. 93.]

Special Order Modifying Quarantine Line for the State of Virginia—1902.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 11, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of Virginia has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning at the boundary line of Virginia at its southwestern corner (Lee County); thence east along the southern boundary of Virginia to the southwestern corner of Patrick County; thence northerly along the western boundaries of Patrick and Franklin counties to Daniels Run; thence easterly along Daniels Run and the Blackwater River to the Staunton River; thence in a southeasterly and northeasterly direction along the southern and eastern boundaries of Bedford County to the James River; thence following the James River to the southeastern corner of Charles City County; thence northerly and easterly along the western and northern boundaries of James City County to the western boundary of Gloucester County at the York River; thence southerly and northerly along the southern and eastern boundaries of Gloucester County to the northeastern corner of said county; thence easterly and southerly along the northern and eastern boundaries of Mathews County to the southeastern point of said county; thence south to the northern boundary of Elizabeth City County; thence westerly and northerly along the boundaries of Elizabeth City and Warwick counties to the James River; thence southeasterly along the course of the said river to the northwest corner of Norfolk County; thence south along the western boundary of said county to its intersection with the northern boundary of North Carolina; thence east along the southern boundaries of Norfolk and Princess Anne counties to the Atlantic Ocean."

And whereas said quarantine line as above set forth is satisfactory to this Department and legislation has been enacted by the State of Virginia to enforce said quarantine line, therefore the above quarantine line is adopted for the State of Virginia by this Department for the period beginning on February 1, 1902, and ending January 31, 1903, in lieu of the quarantine line described in the order of January 10, 1902, for said area, unless otherwise ordered.

It is further ordered, That, during the continuance of the above line, no cattle shall be moved or allowed to move from the counties of Henrico, Goochland, Louisa, Fluvanna, Albemarle, and Nelson to any of that territory in the State of Virginia lying east, west, and north of said counties, except after having been inspected and found free of infection by duly authorized inspectors of this Department or of the State of Virginia and upon written permission by such officer. No cattle from said counties shall be moved or allowed to move to any State or Territory outside of the quarantined district (except as provided for immediate slaughter), unless they have been duly inspected and passed and permit issued by inspectors of this Department, nor until permission has been obtained from the proper officials of the State or Territory to which destined.

JAMES WILSON, *Secretary*.

[AMENDMENT NO. 8 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Feeding Stations in the Quarantined District for Uninfected Cattle.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 11, 1902.

It is hereby ordered, That cattle originating outside, north, east, and west of the quarantine line, as defined in Bureau of Animal Industry Order No. 93 (January 10, 1902), or amendments thereto, and which are to be transported by rail through the quarantined district, may be unloaded for rest, feed, and water into uninfected pens set apart for such cattle at Polk Stock Yards and Union Stock Yards, Fort Worth, Tex.; Baird, Tex.; Southern Pacific Railway Stock Yards, Los Angeles, Cal.; Bakersfield, Cal.; and at Salisbury, N. C.: *Providing*, The cattle are free from Southern cattle ticks and have not been unloaded at any other place within the quarantined district. They may, after unloading into said pens, be reloaded into the same cars from which unloaded, or into other cleaned and disinfected cars, and reshipped as uninfected cattle.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 9 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Movement of Southern Cattle into Kansas and Virginia.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 23, 1902.

It is hereby ordered, That section 3 of B. A. I. Order No. 93, dated January 10, 1902, providing for the movement of cattle from the quarantined district described by said order and amendments thereto, be amended as follows:

From February 1 to February 20, 1902, inclusive, native cattle from below the Federal quarantine line may be moved into the State of Kansas, for grazing or feeding purposes, provided such cattle are to remain in that State for a period of not less than three months from the date of crossing the line, and further provided that such cattle are inspected and found free from infection by a duly authorized inspector of this Department or of the State of Kansas, and upon written permission of such officer.

And it is further ordered, That cattle from the counties of Henrico, Goochland, Louisa, Fluvanna, Albemarle, and Nelson, in the State of Virginia, may be moved until March 1, 1902, without restrictions other than may be enforced by local regulations at the point of destination.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 10 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Moving Cattle from Two Northern Tiers of Counties in Arkansas.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., February 13, 1902.

It is hereby ordered, That B. A. I. Order No. 93, dated January 10, 1902, be amended so as to permit the shipment of cattle for purposes other than immediate slaughter from the two northern tiers of counties in the State of Arkansas into the noninfected area: *Provided*, That said cattle have remained in the above-

described counties since January 1 of this year and have been inspected by officers of the Bureau of Animal Industry of this Department and found to be free of splenetic, or Texas, fever and not to have been exposed to the contagion thereof; that proper facilities have been afforded for making such inspection; and that after inspection the cattle shall be shipped without delay and without exposure to the infection of splenetic, or Texas, fever.

Provided further, That no cattle shall be allowed shipment under this order unless accompanied by a written permit issued by an inspector of the Bureau of Animal Industry, nor shall such cattle be taken into any State or Territory contrary to the local regulations; and said permission will be granted only for cattle which are to remain within the State to which destined for three months after arrival.

This order to remain in force until April 1, 1902.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 11 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Movement of Cattle in Virginia.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 1, 1902.

It is hereby ordered, That the last paragraph of Amendment No. 7 to B. A. I. Order 93, dated January 10, 1902, be revoked.

Cattle from the counties of Henrico, Goochland, Louisa, Fluvanna, Albemarle, and Nelson in the State of Virginia may be moved without restrictions other than may be enforced by local regulations at the point of destination.

J. H. BRIGHAM, *Acting Secretary.*

[AMENDMENT NO. 12 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Permitting Movement of Cattle from Certain Portions of Ponca Indian Reservation.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1902.

It is hereby ordered, That section 3 of B. A. I. Order 93, dated January 10, 1892, be amended so as to permit the shipment of cattle for other purposes than immediate slaughter to points in the noninfected area from that portion of the Ponca Indian Reservation, Oklahoma, situated south of the Salt Fork of the Arkansas River and east of the right of way of the Atchison, Topeka and Santa Fe Railway: *Provided*, That said cattle have been kept in the above-described area since January 1, 1902, and have been inspected by an officer of the Bureau of Animal Industry of this Department and found free of splenetic, or Texas, fever and not to have been exposed to the contagion thereof.

And provided further, That no cattle shall be allowed shipment from this area unless accompanied by a written permit, issued by an officer of the Bureau of Animal Industry, and all such cattle shall be subject to the laws and regulations of the State to which destined. The cars in which such cattle are shipped must be free from infection and satisfactory to the officer supervising the shipment.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 13 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Removal of Special Quarantine, Henderson County, N. C.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., April 16, 1902.

It is ordered, That the portion of Amendment No. 6 to B. A. I. Order No. 93, dated January 11, 1902, relating to the movement of cattle from a certain part of Henderson County, N. C., be and the same is hereby revoked.

Cattle from Henderson County may, until further order, be moved without restrictions, but no cattle shall be moved or allowed to move from the counties of Surry, Wilkes, Caldwell, Burke, and McDowell, of North Carolina, except as provided in the amendment named.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 14 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Special Order Providing for Return to Noninfected District of Cattle Exhibited at the Southern Interstate Fair at Atlanta, Ga.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., June 28, 1902.

It is hereby ordered, That cattle from above the Federal quarantine line which have been shipped directly from the noninfected district to the fair grounds at Atlanta, Ga., for exhibition purposes at the Southern Interstate Fair, to be held from October 8 to October 25, 1902, and which are returned without being unloaded elsewhere, be permitted to return as uninfected cattle, provided they are accompanied by a certificate issued by an inspector of the Bureau of Animal Industry of this Department showing that such cattle have had no opportunity to become infested with the cattle tick (*Boophilus annulatus*) while at said fair grounds.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 15 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Movement of Cattle from a Certain Part of Oklahoma.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., July 30, 1902.

It is hereby ordered, That, owing to the existence of Texas fever infection among cattle in the Ponca and Otoe Indian reservations west of the right of way of the Atchison, Topeka and Santa Fe Railway, no cattle in said area shall be moved or allowed to move, except as provided for Southern cattle for immediate slaughter, to the noninfected part of the Territory of Oklahoma, except after inspection and being found free of infection by duly authorized inspectors of this Department or of the Territory of Oklahoma, and upon written permission by such officer, nor to any State or Territory outside of the quarantined district unless they have been duly inspected and passed and have a permit issued by an inspector of this Depart-

ment, and permission has been obtained from the proper officials of the State or Territory to which destined.

The special order modifying the quarantine line for the Territory of Oklahoma (Amendment No. 3 to B. A. I. Order No. 93) is hereby modified in accordance with the above.

WILLIS L. MOORE, *Acting Secretary.*

[AMENDMENT NO. 16 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Special Order Relating to Exhibition of Cattle at the California State Fair, September, 1902.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., July 30, 1902.

It is hereby ordered, That cattle from that part of California quarantined on account of Southern cattle fever may be exhibited at the California State fair at Sacramento, September 8 to 20, 1902, provided they are shipped direct from point of origin to the fair grounds in clean and disinfected cars; that they are accompanied by a certificate issued by the State veterinarian stating that he has inspected the cattle before shipment and found them to be free from the Texas fever tick (*Boophilus annulatus*); that while at the fair grounds said cattle are not brought into contact with other cattle from the noninfected area; and that, when the exhibition is closed, said cattle shall be shipped direct from the fair grounds to the quarantined area.

The special order modifying the quarantine line for the State of California (Amendment No. 1 to B. A. I. Order No. 93) is hereby modified in accordance with the above.

WILLIS L. MOORE, *Acting Secretary.*

[AMENDMENT NO. 17 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Special Quarantine of Cattle in Oklahoma.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., September 10, 1902.

It is hereby ordered, That, owing to the existence of Texas fever infection in the Territory of Oklahoma, no cattle shall be moved or allowed to move, except as provided for Southern cattle for immediate slaughter, to any portion of the uninfected area from the Territory of Oklahoma except from Beaver, Woodward, Woods, Kingfisher, Garfield, Grant, and Kay counties, unless after inspection they are found free of infection by duly authorized inspectors of the Bureau of Animal Industry of this Department, and upon written permission by such officers.

The special order modifying the quarantine line for the Territory of Oklahoma (Amendment No. 3 to B. A. I. Order No. 93) is hereby modified in accordance with the above.

J. H. BRIGHAM, *Acting Secretary.*

[AMENDMENT NO. 18 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Special Quarantine of Certain Counties in Kentucky.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 10, 1902.

Owing to the existence of splenetic, or Southern, fever infection among cattle in certain counties in Kentucky, as shown by the number of cattle in these counties infested with the Southern cattle tick (*Boophilus annulatus*), and to prevent the spread of infection,

It is hereby ordered, That no cattle which are in Clinton, Wayne, and Pulaski counties, Kentucky, or which may be taken into said counties during the continuance of this order, shall be moved or shipped to any State or Territory except for immediate slaughter in accordance with the regulations of this Department (B. A. I. Order No. 93, dated January 10, 1902, or amendments thereto) for the movement of Southern cattle. This order to continue from this date to November 15, 1902.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 19 TO B. A. I. ORDER NO. 93.]

Regulations Concerning Cattle Transportation—Restrictions Modified.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 22, 1902.

It is hereby ordered, That section 3 of B. A. I. Order No. 93, dated January 10, 1902, providing for the movement of cattle from the quarantined district described by said order and amendments thereto, be amended as follows:

From November 1, 1902, to January 31, 1903, inclusive, cattle from said area may be moved for purposes other than immediate slaughter to such points within the States of Virginia, North Carolina, Tennessee, Missouri, Kansas, and the Territories of New Mexico and Arizona, and from November 1 to December 31, 1902, inclusive, to such points within the State of Texas and the Territory of Oklahoma, as may be provided for in the regulations of these States and Territories and permitted by the local authorities in charge. In the absence of such local regulations and permission, all movement of cattle from the quarantined district to points outside of said district in above-named States and Territories is prohibited, except as provided for immediate slaughter. All cattle from the quarantined district destined to points outside of the States and Territories above named may be shipped without inspection between November 1, 1902, and January 31, 1903, inclusive, and without restrictions other than may be enforced by local regulations at point of destination. The reshipment of any cattle which may have been moved under this order to any part or parts of the States of Virginia, North Carolina, Tennessee, Missouri, Kansas, and Texas, and the Territories of Oklahoma, New Mexico, and Arizona, to any other of said States and Territories, except by permission of the proper authorities of the State or Territory to which destined, is hereby prohibited.

And it is further ordered, That all stock pens which may have been reserved for the use of cattle from the quarantined district, prior to November 1 next, shall not be used for receiving or storing cattle from the quarantined district which have been inspected and passed, nor for cattle originating outside of the quarantined district, except when such cattle are intended for immediate slaughter.

J. H. BRIGHAM, *Acting Secretary.*

[AMENDMENT NO. 9 TO B. A. I. ORDER NO. 56.]

Regulations for the Inspection and Quarantine of Horses, Neat Cattle, Sheep, and other Ruminants, and Swine Imported into the United States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 22, 1902.

It is hereby ordered, That Rule 1 of the regulations for the inspection and quarantine of horses, neat cattle, sheep, and other ruminants, and swine, imported into the United States, issued under date of December 28, 1899 (B. A. I. Order No. 56), be, and is hereby, amended by the addition of Clayton, N. Y., as an animal quarantine station for the inspection and quarantine of animals imported into the United States.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 10 TO B. A. I. ORDER NO. 56.]

Regulations for the Inspection and Quarantine of Horses, Neat Cattle, Sheep, and other Ruminants, and Swine Imported into the United States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., May 7, 1902.

It is hereby ordered, That Rule 6 of the regulations for the inspection and quarantine of horses, neat cattle, sheep, and other ruminants, and swine imported into the United States, issued under date of December 28, 1899 (B. A. I. Order No. 56), be, and is hereby, amended to provide for the admission, without inspection, at Fort Kent, Me., of the following animals: Oxen and horses for work purposes; cattle, sheep, and swine for slaughter. This order shall terminate December 31, 1902.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 11 TO B. A. I. ORDER NO. 56.]

Regulations for the Inspection and Quarantine of Horses, Neat Cattle, Sheep, and other Ruminants, and Swine Imported into the United States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., August 20, 1902.

It is hereby ordered, That Rule 1 of the regulations for the inspection and quarantine of animals imported into the United States issued under date of December 28, 1899 (B. A. I. Order 56), be, and is hereby, amended by the addition of Lowelltown, Me. (port of Bangor, Me.), as an animal quarantine station during the months of September, October, and November, 1902, for the inspection and quarantine of animals imported into the United States. This order to terminate November 30, 1902.

WILLIS L. MOORE, *Acting Secretary.*

[AMENDMENT NO. 12 TO B. A. I. ORDER NO. 56.]

Regulations for the Inspection and Quarantine of Horses, Neat Cattle, Sheep, and other Ruminants, and Swine Imported into the United States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 25, 1902.

It is hereby ordered, That cattle imported into the United States directly from the islands of Jersey and Guernsey may be admitted without being tested with tuberculin.

Rule 5 of the regulations for the inspection and quarantine of animals imported into the United States, issued under date of December 28, 1899 (B. A. I. Order No. 56), as amended by the order of March 21, 1901 (amendment No. 5 to B. A. I. Order No. 56), is hereby modified in accordance with the above.

J. H. BRIGHAM, *Acting Secretary.*

[AMENDMENT NO. 13 TO B. A. I. ORDER NO. 56.]

Regulations for the Inspection and Quarantine of Horses, Neat Cattle, Sheep, and other Ruminants, and Swine Imported into the United States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 15, 1902.

It is hereby ordered. That Rule 1 of the regulations for the inspection and quarantine of horses, neat cattle, sheep, and other ruminants, and swine imported into the United States, issued under date of December 28, 1899 (B. A. I. Order No. 56), be, and is hereby, amended by the addition of Lisbon, N. Y. (port of Ogdensburg, N. Y.), as a point for the entry of animals which require inspection only and are not subject to quarantine.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 2 TO B. A. I. ORDER NO. 33.]

Regulations for the Inspection of Live Stock and their Products.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., June 21, 1902.

It is hereby ordered, That section 10 of the regulations for the inspection of live stock and their products, issued under date of March 15, 1899 (B. A. I. Order No. 33), be, and is hereby, amended by the addition of the following paragraph:

(*d*) Where hot branding irons or other instruments are used to imprint hams, bacon, or other product with the name of the packer or trade-mark and it is desired in addition to indicate that the meat has been inspected by the Department of Agriculture, the wording employed for this purpose, and which must be in letters of sufficient size to be legible, shall be as follows: No. ([a]). U. S. Insp'd.

JAMES WILSON, *Secretary.*

(Amendment No. 1 was issued as B. A. I. Order No. 78.)

[a] Insert official number of establishment.

[B. A. I. ORDER NO. 94.]

Rules and Regulations Prescribed in Regard to "Renovated Butter," in Accordance with the Act of Congress approved May 9, 1902, and Information Concerning "Adulterated Butter."

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., June 21, 1902.

The act of Congress approved May 9, 1902, and popularly known as "the oleomargarine law," assigned to the Secretary of the Treasury and the Secretary of Agriculture various duties concerning those grades or kinds of butter defined in the law as "adulterated butter" and "process or renovated butter." The two officers named have accordingly formulated and approved the necessary rules and regulations for carrying into effect the provisions of the said law, and the same have been published as a part of "Regulations No. 9, Revised June 1902, United States Internal Revenue."

So much of those rules and regulations as relates to renovated butter and the duties of the Secretary of Agriculture in connection therewith, are hereby republished for the guidance of officers and employees of this Department concerned therewith, and for the information of all interested. For general information, certain matters are added relating to adulterated butter.

Extracts from the law of May 9, 1902.

* * * * * * *

"SEC. 4. That for the purpose of this act 'butter' is hereby defined to mean an article of food as defined in 'An act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine,' approved August second, eighteen hundred and eighty-six;[a] that 'adulterated butter' is hereby defined to mean a grade of butter produced by mixing, reworking, rechurning in milk or cream, refining, or in any way producing a uniform, purified, or improved product from different lots or parcels of melted or unmelted butter or butter fat, in which any acid, alkali, chemical, or any substance whatever is introduced or used for the purpose or with the effect of deodorizing or removing therefrom rancidity, or any butter or butter fat with which there is mixed any substance foreign to butter as herein defined, with intent or effect of cheapening in cost the product, or any butter in the manufacture or manipulation of which any process or material is used with intent or effect of causing the absorption of abnormal quantities of water, milk, or cream; that 'process butter' or 'renovated butter' is hereby defined to mean butter which has been subjected to any process by which it is melted, clarified, or refined and made to resemble genuine butter, always excepting 'adulterated butter' as defined by this act.

"That special taxes are imposed as follows:

"Manufacturers of process or renovated butter shall pay fifty dollars per year and manufacturers of adulterated butter shall pay six hundred dollars per year.

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[a] The definition of "butter" first above referred to is the first section of the act approved August 2, 1886, and known as the original oleomargarine law. It is as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the purpose of this act the word "butter" shall be understood to mean the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter.

Every person who engages in the production of process or renovated butter or adulterated butter as a business shall be considered to be a manufacturer thereof.

"Wholesale dealers in adulterated butter shall pay a tax of four hundred and eighty dollars per annum and retail dealers in adulterated butter shall pay a tax of forty-eight dollars per annum. Every person who sells adulterated butter in less quantities than ten pounds at one time shall be regarded as a retail dealer in adulterated butter.

"Every person who sells adulterated butter shall be regarded as a dealer in adulterated butter. And sections thirty-two hundred and thirty-two, thirty-two hundred and thirty-three, thirty-two hundred and thirty-four, thirty-two hundred and thirty-five, thirty-two hundred and thirty-six, thirty-two hundred and thirty-seven, thirty-two hundred and thirty-eight, thirty-two hundred and thirty-nine, thirty-two hundred and forty, thirty-two hundred and forty-one, and thirty-two hundred and forty-three of the Revised Statutes of the United States are, so far as applicable, made to extend to and include and apply to the special taxes imposed by this section and to the person upon whom they are imposed.

"That every person who carries on the business of a manufacturer of process or renovated butter or adulterated butter without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than one thousand and not more than five thousand dollars; and every person who carries on the business of a dealer in adulterated butter without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than fifty nor more than five hundred dollars for each offense.

"That every manufacturer of process or renovated butter or adulterated butter shall file with the collector of internal revenue of the district in which his manufactory is located such notices, inventories, and bonds, shall keep such books and render such returns of material and products, shall put up such signs and affix such number of his factory, and conduct his business under such surveillance of officers and agents as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may by regulation require. But the bond required of such manufacturer shall be with sureties satisfactory to the collector of internal revenue, and in a penal sum of not less than five hundred dollars; and the sum of said bond may be increased from time to time and additional sureties required at the discretion of the collector or under instructions of the Commissioner of Internal Revenue.

* * * * * * *

"That upon adulterated butter, when manufactured or sold or removed for consumption or use, there shall be assessed and collected a tax of ten cents per pound, to be paid by the manufacturer thereof, and any fractional part of a pound shall be taxed as a pound, and that upon process or renovated butter, when manufactured or sold or removed for consumption or use, there shall be assessed and collected a tax of one-fourth of one cent per pound, to be paid by the manufacturer thereof, and any fractional part of a pound shall be taxed as a pound. The tax to be levied by this section shall be represented by coupon stamps, and the provisions of existing laws governing engraving, issuing, sale, accountability, effacement, and destruction of stamps relating to tobacco and snuff, so far as applicable, are hereby made to apply to the stamps provided by this section.

* * * * * * *

"SEC. 5. All parts of an act providing for an inspection of meats for exportation, approved August thirtieth, eighteen hundred and ninety, and of an act to provide for the inspection of live cattle, hogs, and the carcasses and products thereof which are the subjects of interstate commerce, approved March third, eighteen hundred and ninety-one, and of amendment thereto approved March second,

eighteen hundred and ninety-five, which are applicable to the subjects and purposes described in this section shall apply to process or renovated butter. And the Secretary of Agriculture is hereby authorized and required to cause a rigid sanitary inspection to be made, at such times as he may deem proper or necessary, of all factories and storehouses where process or renovated butter is manufactured, packed, or prepared for market, and of the products thereof and materials going into the manufacture of the same. All process or renovated butter and the packages containing the same shall be marked with the words 'Renovated butter' or 'Process butter' and by such other marks, labels, or brands and in such manner as may be prescribed by the Secretary of Agriculture, and no process or renovated butter shall be shipped or transported from its place of manufacture into any other State or Territory or the District of Columbia, or to any foreign country, until it has been marked as provided in this section. The Secretary of Agriculture shall make all needful regulations for carrying this section into effect, and shall cause to be ascertained and reported from time to time the quantity and quality of process or renovated butter manufactured, and the character and the condition of the material from which it is made. And he shall also have power to ascertain whether or not materials used in the manufacture of said process or renovated butter are deleterious to health or unwholesome in the finished product, and in case such deleterious or unwholesome materials are found to be used in product intended for exportation or shipment into other States, or in course of exportation or shipment, he shall have power to confiscate the same. Any person, firm, or corporation violating any of the provisions of this section shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine of not less than fifty dollars nor more than five hundred dollars, or by imprisonment not less than one month nor more than six months, or by both said punishments, in the discretion of the court."

RULES AND REGULATIONS PRESCRIBED IN REGARD TO "RENOVATED BUTTER" (OR "PROCESS BUTTER") IN ACCORDANCE WITH THE ACT OF CONGRESS APPROVED MAY 9, 1902.

1. As the terms "process butter" and "renovated butter" occur throughout the act as synonymous, the article will be designated as "renovated butter" in these regulations and in all correspondence relating thereto.

2. The following explanation of the definition of renovated butter as it occurs in the law has been prepared by the Department of Agriculture and is adopted for guidance in connection with these regulations:

(*a*) This grade or kind of butter may be made from one or more lots or parcels of butter which has been or have been "subjected to any process by which it is melted, clarified, or refined and made to resemble genuine butter, always excepting 'adulterated butter' as defined by this act."

(*b*) The butter, to be subject to this definition, must have been melted—that is, so affected by heat as to become of sufficient fluidity to move in a continuous stream of even consistency from one vessel to another, by pouring or pumping, because butter can not be "clarified or refined" unless it be melted to that degree.

(*c*) The butter must, besides melting, have been subjected to some process by which it is "clarified or refined." Butter or melted butter may be clarified or refined by skimming, settling, aerating, washing, and other processes, through the action of heat, cold, agitation or motion, or rest.

(*d*) Butter thus melted and clarified or refined becomes an oil or fat almost free from taste and odor. To be again "made to resemble genuine butter" it must have restored to it the butter characteristics or similitude of texture, granulation, and flavor. For this purpose the processed or renovated butter is usually granu-

lated by cooling and churned or otherwise mixed with milk or skim milk, or buttermilk, or cream, sweet or sour. It may or may not have common salt or artificial coloring added. To "resemble genuine butter" the article must have passed through these or other processes subsequent to melting, so that it looks, smells, and tastes like "butter," having a similar appearance, consistency, texture, and flavor.

(*e*) It may be assumed that the object of subjecting a lot or lots of butter to such a process is to remove rancidity, sourness, mold, or other fault or feature which has impaired its merchantable quality, or to otherwise renew or improve the product, so that the substance is truly "renovated," although such object is not expressed in the act.

(*f*) But if in such process, "or in any (other) way," "any acid, alkali, chemical, or any substance whatever is introduced" or used, or if "there is mixed (therewith) any substance foreign to butter" (including any fat or oil other than butter fat), or if in any way the substance is made to hold "abnormal quantities of water, milk, or cream," the substance or commodity is to be recognized and treated as "adulterated butter" under this act.

(*g*) Renovated butter having 16 per cent or more of moisture will be held to contain "abnormal quantities of water, milk, or cream," and be, therefore, classed as "adulterated butter."

3. Section 4 of the act of May 9, 1902: "Manufacturers of process or renovated butter shall pay fifty dollars per year. * * * Every person who engages in the production of process or renovated butter * * * as a business shall be considered a manufacturer thereof." The special-tax year begins July 1. The special tax of manufacturers who commence business in the month of July will be reckoned for one year, and the tax of manufacturers who commence business after the month of July will be reckoned proportionately from the first day of the month from which the liability to special tax commenced to the 1st day of July following.

4. Every manufacturer of renovated butter, before commencing business (or at least within the month in which liability to special tax commenced), must register with the collector of the district in which the business is to be carried on his name or style, place of residence, business, and the place where such business is to be carried on, and procure a special-tax stamp at the rate of $50 per annum, which stamp he is to place and keep conspicuously posted in his establishment or place of business; and on the first day of July in each year he will again so register and procure a new special-tax stamp and post it as above stated.

5. Under the provisions of section 4 of said act the tax of one-fourth of 1 cent per pound imposed thereby on renovated butter is to be represented by coupon stamps, to be provided by the Commissioner of Internal Revenue as authorized by existing laws. A fractional part of a pound shall be taxed as a pound.

6. For this purpose tax-paid stamps will be furnished in denominations of 10, 20, 30, 40, 50, 60, and 100 pounds, each stamp bearing nine coupons. Such stamps must contain the name of the collector, his district and State, and show thereon the date of payment of the tax, the number of pounds, and the number of the factory.

7. On the withdrawal of a package of renovated butter the proper tax-paid stamp must be affixed thereto by the manufacturer by the use of adhesive material, and not less than five tacks must be driven through each stamp, one in each corner and one in the middle of the stamp. The stamp when so affixed must be immediately canceled. For the purpose of cancellation the manufacturer will use a stencil plate of brass or copper, in which will be cut five fine parallel waved lines long enough to extend beyond each side of the stamp onto the wood of the

package. The imprinting from this plate must be with blacking or other durable coloring material over and across the stamp, and in such manner as not to deface the reading matter on the stamp—that is, so as not to daub and make it illegible.

8. The stamp must be affixed to the side of the package, to a smooth surface, in such a manner as to be readily canceled in the manner above described. When a package contains a number of pounds between 10 and 20, a *ten* pound stamp with the necessary number of coupons attached will be issued to cover the net weight. Packages containing more than 20 pounds and less than 30 pounds will have attached a *twenty* pound stamp with a suitable number of coupons to represent the contents. Larger sized packages will be similarly stamped.

9. Every manufacturer of renovated butter will be required to file with the collector a notice on Form No. 507, together with an inventory, Form No. 509, when making application for special-tax stamp as manufacturer. At the same time he will file a bond, Form No. 508, in a penal sum to be fixed by the collector of internal revenue for his district, but in no case less than $500.

Collectors of internal revenue will decline to approve the bond of a manufacturer of renovated butter until satisfied that the premises to be used for the manufacture of that article are entirely separate from those used for the manufacture of adulterated butter or oleomargarine, or for the handling or manipulation of butter not taxable under the act of May 9, 1902.

10. Each manufacturer of renovated butter is required to keep books and make returns showing the quantity of materials received on the factory premises and the quantity of finished materials removed therefrom. Sample pages of book (Form No. 511) to be kept by manufacturers will be furnished to collectors, but the book must be provided by the manufacturer, as the same is not supplied by the Government.

11. Form No. 499 has been prescribed for monthly returns of manufacturers of renovated butter, and such forms will be furnished through the collectors of internal revenue.

12. Collectors will give to each manufacturer of renovated butter in their respective districts a factory number, the numbers to be consecutive and not thereafter changed. The factory number applies to the manufacturer and his establishment rather than to the building.

13. Every manufacturer of renovated butter shall place and keep on the side or end of the building wherein his business is carried on, so that it can be distinctly seen, a sign with letters thereon not less than 3 inches in length, printed in oil colors or gilded, giving his full name and business and the number of his factory, as follows:

A——— B———

MANUFACTURER OF RENOVATED BUTTER.

Factory No. ——.

14. Whenever any manufacturer's package of renovated butter is empty it will be the duty of the person who removes the contents thereof to utterly destroy the tax-paid stamp on such empty package. Any person having in his possession empty renovated butter packages from which the tax-paid stamps have not been removed will be liable to a heavy penalty.

15. Section 5 of said act of May 9, 1902, requires that all renovated butter and the packages containing the same shall be marked with the words "Renovated butter" or "Process butter," and by such other marks, labels, or brands, and in

such manner as may be prescribed by the Secretary of Agriculture. To carry this provision into effect the Secretary of Agriculture prescribes the following rules for l' beling, marking, and branding.

16. Each manufacturer's package of renovated butter shall have manufactory and the district and State in which it is situated, together with the following notice:

FOR RENOVATED BUTTER.

Factory No. ——, —— district, State of ——.

Notice.

"The manufacturer of the renovated butter (or process butter) herein contained has complied with all the requirements of the law. Every person is cautioned not to use either this package again or the stamp thereon again, nor to remove the contents of this package without destroying said stamp, under penalty provided by law in such cases."

The label on which the above notice is to be printed is required to be not less than 4 nor more than 6 inches long, and not less than 2½ inches in width. The label must be securely affixed by paste to the top or cover of the package in such a way as to be exposed to public view and easily read. The words "Renovated butter" in this notice must be printed in plain gothic letters at least three-eighths inch square. There must also be plainly marked or stenciled on the outside of each package the gross, tare, and net weight in pounds.

17. All renovated butter may be packed by the manufacturer thereof in firkins, tubs, or packages of wood or other suitable material not before used for that purpose; but each package must contain not less than 10 pounds; and, when packed in a solid body or mass, there shall be stamped or branded into the upper surface of the butter the words "Renovated Butter" in one or two lines, the letters to be gothic style, not less than one-half inch square and depressed not less than one-eighth inch.

18. Manufacturers will be permitted to pack prints, bricks, or rolls of renovated butter; but each print, brick, or roll must have stamped thereon the words "Renovated butter," in two lines, the letters to be depressed, of gothic style, not less than three-eighths inch square and sunken not less than one-eighth inch.

19. The use of inner packages of wood, paper, or other materials containing not less than one pound each will be permitted, but such inner packages must have the words "Renovated butter," in one or two lines, conspicuously marked, branded, or stamped on the top or side of each inner package in full-faced gothic letters not less than three-eighths inch square. If such inner packages are wrapped with paper or cloth covering, such wrapper must be marked in the same manner.

20. If such manufacturers desire to place upon the outside of their original packages, as above described, their names or some word or mark descriptive of the quality of the product, they may do so, provided such brand does not obscure or cover up any of the stamps, marks, or brands otherwise required for such packages. For example:

JOHN DOE, Manufacturer of RENOVATED BUTTER, 20 1-lb. Plain Bricks.	RICHARD ROE, Manufacturer of Elgin, RENOVATED BUTTER, Solid.

21. When so marked the words "Renovated butter" must be included in the brand or stenciled in plain roman letters not less in size than the letters used in the manufacturers' name, etc. The figures and words describing the form in

which contents are packed must not be greater than one-half the size of the letters prescribed for the words "Renovated butter."

22. The law neither defines nor imposes special taxes upon wholesale or retail dealers in renovated butter. Neither does it describe the manner of sale of such product by dealers. However, renovated butter should always bear or be accompanied by the evidence that the manufacturer's tax thereon has been paid. Therefore, it should not be removed nor separated from the original package bearing the tax stamp and other prescribed marks, when it is in transportation, the subject of interstate commerce, exported, or whenever and wherever offered for sale, until delivered to the consumer or purchaser in retail trade.

23. Attention is called to the fact that the act named makes no provision for the exportation, free of tax, of renovated butter; nor for drawback of tax on such articles when exported. Consequently, all renovated butter for export must be stamped and marked the same as for the domestic market.

24. All factories where renovated butter is manufactured, packed, or prepared for market, as well as the materials used and to be used, the processes and the products, will be inspected from time to time by officers or agents specially designated for that purpose by the Secretary of Agriculture. Inspectors will be required to report upon "the character and condition of the material" and "the quantity and quality" of the product in such manner as may be prescribed.

25. Correspondence and all administrative details under the rules numbered 3 to 14, inclusive, above, are assigned to the Commissioner of Internal Revenue, Treasury Department. And, similarly, all matters under the rules 15 to 24, inclusive, are assigned to the Dairy Division, Bureau of Animal Industry, Department of Agriculture.

JAMES WILSON,
Secretary of Agriculture.

Approved:

L. M. SHAW,
Secretary of the Treasury.

EXTRACTS REGARDING ADULTERATED BUTTER.

The following extracts from the Treasury regulations refer mainly to adulterated butter:

(In explanation of the first part of section 4, act of May 9, 1902.)

The evident intent of this section is to define all products properly known or designated as butter, and to separate them into three classes for the purposes of the act. The first paragraph of the section adopts the definition of "butter" used in the act of August 2, 1886, as being "The food product usually known as butter, which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter."

All butter which does not come under the terms of this definition, therefore, necessarily falls into one of the other two classes, upon which a tax is laid.

The next paragraph of the section defines "adulterated butter," the product which bears the higher rate of tax, in a long clause, which is evidently intended to describe with some particularity well-defined forms of adulteration as examples or guides.

Such are, first, "A grade of butter produced by mixing, reworking, rechurning in milk or cream, refining, or in any way producing a uniform, purified, or improved product from different lots or parcels of melted or unmelted butter or butter fat, in which any acid, alkali, chemical, or any substance whatever is introduced or used for the purpose, or with the effect of deodorizing or removing therefrom rancidity;" or, second, "Any butter or butter fat with which there is

mixed any substance foreign to butter as herein defined, with intent or effect of cheapening in cost the product or any butter in the manufacture or manipulation of which any process or material is used with intent or effect of causing the absorption of abnormal quantities of water, milk, or cream."

Briefly stated, the first instance describes reworked or renovated butter to which a foreign substance has been added to "deodorize or remove rancidity;" the second instance describes butter cheapened in cost by admixtures, or made to "contain abnormal quantities of water, etc."

The third paragraph of the section defines "process butter," or "renovated butter," essentially as butter which has been subjected to the processes generally used for the renovation of butter, but *without* the introduction or use of "any acid, alkali, chemical, or any substance whatever," and without being made to contain "abnormal quantities of water, milk, or cream."

It follows, therefore, that "renovated butter" is butter as defined in the law of August 2, 1886, containing nothing foreign to that product, but which, having become impaired in quality, has been subjected to melting and other renovating processes.

Section 4 of said act of May 9, 1902, further provides:

"That all adulterated butter shall be packed by the manufacturer thereof in firkins, tubs, or other wooden packages not before used for that purpose, each containing not less than ten pounds, and marked, stamped, and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe; and all sales made by manufacturers of adulterated butter shall be in original stamped packages.

"Dealers in adulterated butter must sell only original or from original stamped packages, and when such original stamped packages are broken the adulterated butter sold from same shall be placed in suitable wooden or paper packages, which shall be marked and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe. Every person who knowingly sells or offers for sale, or delivers or offers to deliver, any adulterated butter in any other form than in new wooden or paper packages as above described, or who packs in any package any adulterated butter in any manner contrary to law, or who falsely brands any package or affixes a stamp on any package denoting a less amount of tax than that required by law, shall be fined for each offense not more than one thousand dollars and be imprisoned not more than two years."

Section 6 of said act of May 9, 1902, also provides:

"That wholesale dealers in oleomargarine, process, renovated, or adulterated butter shall keep such books and render such returns in relation thereto as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may, by regulation, require; and such books shall be open at all times to the inspection of any internal-revenue officer or agent. And any person who wilfully violates any of the provisions of this section shall for each such offense be fined not less than fifty dollars and not exceeding five hundred dollars, and imprisoned not less than thirty days nor more than six months."

NOTE.—The complete regulations regarding "adulterated butter," as well as those for oleomargarine, may be obtained from the office of the Commissioner of Internal Revenue, Treasury Department, Washington, D. C.

SUPPLEMENTAL NOTICES AND INSTRUCTIONS.

In addition to the foregoing, all persons concerned should note that besides the penalties prescribed in the internal-revenue laws relating to special taxes and tax stamps, and in the laws relating to the inspection of cattle, meats, and meat

products, there are specific penalties named in the last sentence of section 5 of the act of May 9, 1902, for violation of the provisions in that section for shipping and transporting "from its place of manufacture into any other State or Territory or the District of Columbia, or to any foreign country," renovated butter which has not been marked and prepared in all respects in accordance with the foregoing "needful regulations" duly made for carrying the said law into effect.

Samples of the words "Renovated Butter," in full-faced gothic letters one-half inch square and three-eighths inch square, as required by rules 16, 17, 18, and 19, will be found on pages following.

All inspectors, officers, or agents of the Department of Agriculture assigned to duty under this order, or the order of this office dated October 30, 1901 (B. A. I. Order No. 91), will report promptly to the Secretary of Agriculture all violations of these regulations observed by them and all cases of failure to fully conform to the laws herein specified and the rules prescribed for their enforcement. Also, any case in which butter claimed to be "renovated" is believed to be "adulterated butter," in accordance with the legal definition thereof.

All inspectors, officers, or agents of the Department of Agriculture will at all times render every possible assistance to officers and agents of the Commissioner of Internal Revenue, Treasury Department, in the discharge of their duties under the act of May 9, 1902.

Instructions will be issued to agents of this Department from time to time regarding the inspection of factories, routes of transportation, and markets, and the reports to be rendered thereon. All such reports will be addressed to Dr. D. E. Salmon, Chief of the Bureau of Animal Industry.

JAMES WILSON, *Secretary.*

SAMPLE OF FULL-FACED GOTHIC LETTERS.

One-half inch square.

RENOVATED
BUTTER

RENOVATED BUTTER

RENOVATED
BUTTER

Three-eighths inch square.

[B. A. I. ORDER NO. 95.]

Special Order Providing for the Importation of Canadian Animals for Exhibition at the New York State Fair, Syracuse, N. Y.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., June 26, 1902.

It is hereby ordered, That Canadian cattle may be imported into the United States for exhibition purposes at the New York State fair to be held from September 8 to September 13, 1902, at Syracuse, N. Y., without being subjected to the tuberculin test, provided they are accompanied by a certificate issued by a Canadian official veterinarian stating that such cattle are free from contagious and infectious diseases, and provided further that the cattle which are not sold to remain in the United States shall be returned immediately to Canada at the close of the fair.

This Department must be notified of any Canadian cattle that will remain in the United States, and the tuberculin test will be applied to them by an inspector of this Department before shipment to destination is allowed.

All Canadian cattle, sheep, and swine intended for this fair must be shipped directly to the fair grounds and not unloaded in any public stock yards.

JAMES WILSON, *Secretary.*

[B. A. I. ORDER NO. 96.]

Special Order Providing for the Importation of Canadian Cattle, Sheep, and Swine for Exhibition Purposes at International Live-Stock Exposition, Chicago, Ill.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., July 16, 1902.

It is hereby ordered, That Canadian cattle may be imported into the United States for exhibition purposes at the International Live-Stock Exposition, to be held from November 29 to December 6, 1902, at Chicago, Ill., without being subjected to the tuberculin test, provided they are accompanied by a certificate issued by a Canadian official veterinarian stating that such cattle are free from contagious and infectious diseases; and provided further, that the cattle which are not sold to remain in the United States shall be returned immediately to Canada at the close of the Exposition.

This Department must be notified of any Canadian cattle that will remain in the United States, and the tuberculin test will be applied to them by an inspector of this Department before shipment to destination is allowed.

All Canadian cattle, sheep, and swine intended for this Exposition must be shipped directly to the Exposition grounds and not unloaded in any public stock yards.

J. H. BRIGHAM, *Acting Secretary.*

[B. A. I. ORDER NO. 97.]

Extracts from Existing Laws, with Rules and Regulations as Therein Provided, Prescribed for the Inspection and Certification of Renovated Butter and Other Dairy Products for Export.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 1, 1902.

An act making appropriations for the Department of Agriculture, approved March 2, 1901, provides, inter alia, "That the Secretary of Agriculture may construe the provisions of the act of March third, eighteen hundred and ninety-one, as amended March second, eighteen hundred and ninety-five, for the inspection of live cattle and products thereof, to include dairy products intended for exportation to any foreign country and may apply, under rules and regulations to be prescribed by him, the provisions of said act for inspection and certification appropriate for ascertaining the purity and quality of such products, and may cause the same to be so marked, stamped, or labeled as to secure their identity and make known in the markets of foreign countries to which they may be sent from the United States their purity, quality, and grade; and all the provisions of said act relating to live cattle and products thereof for export shall apply to dairy products so inspected and certified."

The provisions of said act of March 3, 1891, as amended by said act of March 2, 1895, have been construed to include and apply to the export of dairy products. (See B. A. I. Order No. 91.)

The said act as amended provides:

"SECTION 2. That the Secretary of Agriculture shall also cause to be made a careful inspection of all live cattle the meat of which—fresh, salted, canned, corned, packed, cured, or otherwise prepared—is intended for exportation to any foreign country, at such times and places and in such manner as he may think proper, with a view to ascertain whether such cattle are free from disease and their meat sound and wholesome, and may appoint inspectors who shall be authorized to give an official certificate clearly stating the condition in which such cattle and meat are found, and no clearance shall be given to any vessel having on board any fresh, salted, canned, corned, or packed beef being the meat of cattle killed after the passage of this act for exportation to and sale in a foreign country from any port in the United States until the owner or shipper shall obtain from an inspector appointed under the provisions of this act a certificate that said cattle were free from disease and that their meat is sound and wholesome."

"SECTION 4. That said examination shall be made in the manner provided by rules and regulations to be prescribed by the Secretary of Agriculture, and after said examination the carcasses and products of all cattle, sheep, and swine found to be free from disease and wholesome, sound, and fit for human food, shall be marked, stamped, or labeled for identification, as may be provided by said rules and regulations of the Secretary of Agriculture. Any person who shall forge, counterfeit, simulate, imitate, falsely represent, or use without authority, or knowingly and wrongfully alter, deface, or destroy any of the marks, stamps, or other devices provided for in the regulations of the Secretary of Agriculture, of any such carcasses or their products, or who shall forge, counterfeit, simulate, imitate, falsely represent, or use without authority, or knowingly or wrongfully alter, deface, or destroy any certificate or stamp provided in said regulations, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding one thousand dollars, or imprisonment not exceeding one year, or by both said punishments, in the discretion of the court."

"SECTION 6. That the inspectors provided for in sections one and two of this act

shall be authorized to give official certificates of the sound and wholesome condition of the cattle, sheep, and swine, their carcasses and products described in sections two and four of this act, and one copy of every certificate granted under the provisions of this act shall be filed in the Department of Agriculture, another copy shall be delivered to the owner or shipper, and when the cattle, sheep, and swine, or their carcasses and products, are sent aboard, a third copy shall be delivered to the chief officer of the vessel on which the shipment shall be made."

In like manner section 5 of the oleomargarine act of May 9, 1902, provides that all parts of an act providing for an inspection of meats for exportation, approved August 30, 1890, and of said act of March 3, 1891, and of said amendment thereto of March 2, 1895, which are applicable to the subjects and purposes described in said section shall apply to process or renovated butter.

Attention is particularly directed to sections 2, 4, and 6, previously quoted, of said act of March 3, 1891, as amended, and also to section 1 of said act of August 30, 1890 (for an inspection of meats for exportation), which, in part, is as follows:

"SECTION 1. * * * Such inspection shall be made at the place where such meats are packed or boxed, and each package of such meats so inspected shall bear the marks, stamps, or other device for identification provided for in the last clause of this section: *Provided*, That an inspection of such meats may also be made at the place of exportation if an inspection has not been made at the place of packing, or if, in the opinion of the Secretary of Agriculture, a reinspection becomes necessary, * * * * and for the identification of the same such marks, stamps, or other devices as the Secretary of Agriculture may by regulation prescribe shall be affixed to each of such packages." * * * *

The act of March 2, 1901, makes the application of the laws previously mentioned to all dairy products for export subject to the discretion of the Secretary of Agriculture. The act of May 9, 1902, is mandatory in applying the provisions quoted to renovated butter exported to any foreign country.

Said oleomargarine act of May 9, 1902, provides in section 5 that "The Secretary of Agriculture shall make all needful regulations for carrying that [this] section into effect," and said act of March 2, 1895, section 4, "That said examination shall be made in the manner provided by rules and regulations to be prescribed by the Secretary of Agriculture;" and said act of March 2, 1901, that the Secretary of Agriculture may prescribe rules and regulations for the application of inspection laws to dairy products.

Notice is accordingly given that the foregoing laws, and rules and regulations prescribed for carrying such laws into effect, are appropriate and applicable and will hereafter be applied to dairy products in general exported or offered for export from the United States, and in particular to renovated butter shipped to any foreign country, as follows:

1. The rules and regulations for the inspection and certification of dairy products in general offered for export from the United States, as prescribed and published in an order dated at this office October 30, 1901 (B. A. I. Order No. 91), are hereby confirmed and renewed, and will continue in force until further notice.

2. The rules and regulations for the manufacture and marking of renovated butter or process butter as prescribed and published in an order dated at this office June 21, 1902 (B. A. I. Order No. 94), are hereby confirmed and renewed and will continue in force, subject to alterations and amendments which may be made and duly published.

(a) Rule 23 of the order last cited is as follows:

"Attention is called to the fact that the act named makes no provision for the exportation, free of tax, of renovated butter; nor for drawback of tax on such articles when exported. Consequently *all renovated butter for export must be stamped and marked the same as for the domestic market.*"

3. All renovated butter to be exported on and after the 12th day of October, 1902, must be inspected and duly certified before delivery to any vessel, carrier, or transportation company. The officers and agents of all vessels sailing from this country for any foreign country, and of all transportation companies carrying merchandise from the United States consigned to any foreign country, are hereby notified that no renovated butter must be received for such carriage and export unless accompanied by the inspection certificate, signed by the Secretary of Agriculture and duly dated and countersigned by an inspecting officer designated for such service. And no clearance shall be given to any vessel having on board any *renovated butter* for exportation to and sale in a foreign country from any port of the United States until the owner or shipper shall obtain from an inspector a certificate that said *renovated butter* is believed to be pure, of legal composition, and suitable for export. (Act of March 3, 1891, sec. 2, as amended March 2, 1895, and subsequently made applicable to the purposes of sec. 5, act of May 9, 1902.)

4. Owners or shippers of renovated butter which is to be exported, whether directly from a port of the United States or indirectly through and from the port of a foreign country, shall make a preliminary and general application in writing for such inspection, addressed to the Secretary of Agriculture. The said application shall state the location or place of business of the party making the same, and also the usual place or places at which the renovated butter may be inspected and from which it is directly transported to the exporting vessel or railway train, and the probable frequency of such exports. (For this purpose the applicant may use the Form D. D. 46, suitably modified, or Form D. D. 46a.)

5. The Secretary of Agriculture will designate an inspector for the service required and duly notify the applicant.

6. The exporter or shipper will notify the inspector of every shipment to be made by him at least twelve hours (and as much longer as practicable) before it is necessary to remove the merchandise to the shipping point and briefly describe the location, form of package, and quantity of renovated butter to be examined. (For this purpose Form D. D. 47 or 47a may be used.) The inspector will not be expected nor required to visit two or more places distant from one another to examine goods to be included in one shipment. If time is available, the examination of any entire shipment may be made at the pier or place of loading for export.

7. An inspection of renovated butter for export may be made at the place of manufacture, and an inspection of such renovated butter may also be made at the place of exportation if an inspection has not been made at the place of packing, or if, in the opinion of the Secretary of Agriculture, a reinspection becomes necessary. (Act of August 30, 1890, sec. 1.) The certificate for export will ordinarily be given by the inspector at the place where the customs papers for export are prepared.

8. The inspector at the place of export will examine the merchandise specified in any notice received from shipper with the least possible delay. And it will be the duty of inspectors to examine any renovated butter for export, upon the application, formal or informal, of transportation companies or their agents, or any such merchandise about to be loaded for export, whether or not notice thereof has been received.

9. Inspectors may examine the renovated butter for export in as much detail as is expedient in their judgment, and may take samples of the same and detain the same until chemical tests of samples can be made, if deemed necessary. If any lot of renovated butter for export is found bearing intact the stamps, marks, and labels prescribed to be placed thereon by the manufacturer, and if the same is shown by the marks thereon to be the product of a factory or factories inspected and approved by the Secretary of Agriculture, the notice of the guaranty or responsibility of the manufacturer being affixed thereto may be accepted as

evidence of purity and manufacture in accordance with law and regulations, and the inspector may execute the prescribed certificate for export. And if in his judgment it be deemed expedient, the inspector may, in exceptional cases, affix to packages containing renovated butter for export such additional stamps, marks, or labels "and in such manner as may be prescribed by the Secretary of Agriculture" from time to time by instructions given to inspectors for the more complete "identification of the same."

10. The inspector will complete, countersign, and issue a certificate of export in the form prescribed and signed by the Secretary of Agriculture. Said certificate shall be dated, shall give the names of consignee and consignor, and shall describe the lot of renovated butter to which it applies. Such description shall include the State, revenue district, and factory number of every factory represented in the lot, and the number of packages from each factory. Said certificates shall state that the renovated butter in question is "the product of approved factories and believed to be pure, of legal composition, and suitable for export;" it shall be issued by serial number in triplicate form. One certificate only shall be issued for each shipment or consignment unless otherwise specially authorized. Both the original and duplicate certificates must be delivered to the exporter. The original is to be attached by him to the bill of lading or manifest accompanying the shipment for the information of the customs authorities, and should be delivered to the chief officer of the vessel upon which said consignment is to be transported and continue with the shipment to destination. The duplicate should be forwarded by the consignor to the consignee to be used by the latter in identifying the shipment at the port of destination by comparison with the original. The stub, which constitutes the third copy of the certificate, shall be completed, preserved by the inspector, and forwarded to the Department.

11. If upon examination the inspector finds any renovated butter offered for export or about to be exported, and which is of doubtful purity notwithstanding the marks upon the same, or incompletely or insufficiently marked for export, or in unwholesome condition and unfit for export, he shall refuse to issue a certificate therefor, and its exportation thereafter will subject all persons concerned therein to the penalties prescribed by law.

12. No renovated butter which has been inspected and certified for export shall have any marks or labels thereon altered or removed in transit, for the purpose of the laws prescribing such marks or labels on such products is "to secure their identity and make known in the markets of foreign countries to which they may be sent from the United States their purity, quality, and grade." In case the marks upon the renovated butter which has been inspected and certified are known to be thereafter in any manner wrongfully removed, altered, or defaced, the inspector shall cancel the certificate already issued for the same and shall forthwith notify the consignor and any transportation company or agent concerned therein of such cancellation.

13. All persons are warned against violating the laws above quoted, which provide heavy penalties for "any person who shall forge, counterfeit, simulate, imitate, falsely represent, or use without authority, or knowingly and wrongfully alter, deface, or destroy any of the marks, stamps, or other devices" placed upon, or any certificate prepared for use or used in connection with, any renovated butter, by authority of the United States.

14. Inspectors and all officers and agents of this Department are instructed to report at once to the Secretary any instance which comes to their knowledge of the violation of any of the provisions of the laws quoted herein or of these regulations (made as duly authorized by law), with all the facts connected therewith, in order that the person or persons offending may be prosecuted as provided by law.

JAMES WILSON, *Secretary of Agriculture.*

[B. A. I. ORDER No. 98.]

Rules and Regulations Prescribed in Regard to "Renovated Butter" in Accordance with the Act of Congress Approved May 9, 1902, and Information Concerning "Adulterated Butter."

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., November 1, 1902.

The act of Congress approved May 9, 1902, and popularly known as "the oleomargarine law," assigned to the Secretary of the Treasury and the Secretary of Agriculture various duties concerning those grades or kinds of butter defined in the law as "adulterated butter" and "process or renovated butter." The two officers named have accordingly formulated and approved the necessary rules and regulations for carrying into effect the provisions of the said law, and the same have been published as a part of "Regulations No. 9, revised June, 1902, United States internal revenue."

The rules and regulations concerning renovated butter and the duties of the Secretary of Agriculture in connection therewith were published from this office under date of June 21, 1902. These have been revised by joint action of the Secretary of the Treasury and the Secretary of Agriculture under date of October 20, 1902. Consequently the said order of June 21 (B. A. I. Order No. 94) is hereby revoked, and in place thereof the said revision is hereby republished for the guidance of officers and employees of this Department concerned therewith, and for the information of all interested. For general information certain matters are added relating to adulterated butter.

Extracts from the law of May 9, 1902.

* * * * * * *

"SEC. 4. That for the purpose of this act 'butter' is hereby defined to mean an article of food as defined in 'An act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine,' approved August second, eighteen hundred and eighty-six;[a] that 'adulterated butter' is hereby defined to mean a grade of butter produced by mixing, reworking, rechurning in milk or cream, refining, or in any way producing a uniform, purified, or improved product from different lots or parcels of melted or unmelted butter or butter fat, in which any acid, alkali, chemical, or any substance whatever is introduced or used for the purpose or with the effect of deodorizing or removing therefrom rancidity, or any butter or butter fat with which there is mixed any substance foreign to butter as herein defined, with intent or effect of cheapening in cost the product or any butter in the manufacture or manipulation of which any process or material is used with intent or effect of causing the absorption of abnormal quantities of water, milk, or cream; that 'process butter,' or 'renovated butter,' is hereby defined to mean butter which has been subjected to any process by which it is melted, clarified or refined and made to resemble genuine butter, always excepting 'adulterated butter' as defined by this act.

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[a] The definition of "butter" referred to is the first section of the original oleomargarine law; it is as follows:

"*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That for the purpose of this Act the word "butter" shall be understood to mean the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter."

"That special taxes are imposed as follows:

"Manufacturers of process or renovated butter shall pay fifty dollars per year and manufacturers of adulterated butter shall pay six hundred dollars per year. Every person who engages in the production of process or renovated butter or adulterated butter as a business shall be considered to be a manufacturer thereof.

"Wholesale dealers in adulterated butter shall pay a tax of four hundred and eighty dollars per annum, and retail dealers in adulterated butter shall pay a tax of forty-eight dollars per annum. Every person who sells adulterated butter in less quantities than ten pounds at one time shall be regarded as a retail dealer in adulterated butter.

"Every person who sells adulterated butter shall be regarded as a dealer in adulterated butter. And sections thirty-two hundred and thirty-two, thirty-two hundred and thirty-three, thirty-two hundred and thirty-four, thirty-two hundred and thirty-five, thirty-two hundred and thirty-six, thirty-two hundred and thirty-seven, thirty-two hundred and thirty-eight, thirty-two hundred and thirty-nine, thirty-two hundred and forty, thirty-two hundred and forty-one, and thirty-two hundred and forty-three of the Revised Statutes of the United States are, so far as practicable, made to extend to and include and apply to the special taxes imposed by this section and to the person upon whom they are imposed.

"That every person who carries on the business of a manufacturer of process or renovated butter or adulterated butter without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than one thousand and not more than five thousand dollars; and every person who carries on the business of a dealer in adulterated butter without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than fifty nor more than five hundred dollars for each offense.

"That every manufacturer of process or renovated butter or adulterated butter shall file with the collector of internal revenue of the district in which his manufactory is located such notices, inventories, and bonds, shall keep such books and render such returns of material and products, shall put up such signs and affix such number of his factory, and conduct his business under such surveillance of officers and agents as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may by regulation require. But the bond required of such manufacturer shall be with sureties satisfactory to the collector of internal revenue, and in a penal sum of not less than five hundred dollars; and the sum of said bond may be increased from time to time and additional sureties required at the discretion of the collector or under instructions of the Commissioner of Internal Revenue.

* * * * * * *

"That upon adulterated butter, when manufactured or sold or removed for consumption or use, there shall be assessed and collected a tax of ten cents per pound, to be paid by the manufacturer thereof, and any fractional part of a pound shall be taxed as a pound, and that upon process or renovated butter, when manufactured or sold or removed for consumption or use, there shall be assessed and collected a tax of one-fourth of one per cent per pound, to be paid by the manufacturer thereof, and any fractional part of a pound shall be taxed as a pound. The tax to be levied by this section shall be represented by coupon stamps, and the provisions of existing laws governing engraving, issuing, sale, accountability, effacement, and destruction of stamps relating to tobacco and snuff, so far as practicable, are hereby made to apply to the stamps provided by this section.

* * * * * * *

"SEC. 5. All parts of an act providing for an inspection of meats for exportation, approved August thirtieth, eighteen hundred and ninety, and of an act to provide for the inspection of live cattle, hogs, and the carcasses and products thereof which are the subjects of interstate commerce, approved March third, eighteen hundred and ninety-one, and of amendment thereto approved March second, eighteen hundred and ninety-five, which are applicable to the subjects and purposes described in this section shall apply to process or renovated butter. And the Secretary of Agriculture is hereby authorized and required to cause a rigid sanitary inspection to be made at such times as he may deem proper or necessary, of all factories and storehouses where process or renovated butter is manufactured, packed or prepared for market, and of the products thereof and materials going into the manufacture of the same. All process or renovated butter and the packages containing the same shall be marked with the words 'Renovated Butter' or 'Process Butter' and by such other marks, labels, or brands and in such manner as may be prescribed by the Secretary of Agriculture, and no process or renovated butter shall be shipped or transported from its place of manufacture into any State or Territory or the District of Columbia, or to any foreign country, until it has been marked as provided in this section. The Secretary of Agriculture shall make all needful regulations for carrying this section into effect, and shall cause to be ascertained and reported from time to time the quantity and quality of process or renovated butter manufactured, and the character and condition of the material from which it is made. And he shall also have power to ascertain whether or not materials used in the manufacture of said process or renovated butter are deleterious to health or unwholesome in the finished product, and in case such deleterious or unwholesome materials are found to be used in product intended for exportation or shipment into other States or in course of exportation or shipment he shall have power to confiscate the same. Any person, firm, or corporation violating any of the provisions of this section shall be deemed guilty of a misdemeanor and on conviction thereof shall be punished by a fine of not less than fifty dollars nor more than five hundred dollars or by imprisonment not less than one month nor more than six months, or by both said punishments, in the discretion of the court."

RULES AND REGULATIONS PRESCRIBED IN REGARD TO "RENOVATED BUTTER" (OR "PROCESS BUTTER") IN ACCORDANCE WITH THE ACT OF CONGRESS APPROVED MAY 9, 1902.

1. As the terms "process butter" and "renovated butter" occur throughout the act as synonymous, the article will be designated as "renovated butter" in these regulations and in all correspondence relating thereto.

2. The following explanation of the definition of renovated butter as it occurs in the law has been prepared by the Department of Agriculture and is adopted for guidance in connection with these regulations:

(*a*) This grade or kind of butter may be made from one or more lots or parcels of butter, which has been or have been "subjected to any process by which it is melted, clarified, or refined and made to resemble genuine butter, always excepting 'adulterated butter' as defined by this act."

(*b*) The butter, to be subject to this definition, must have been melted—that is, so affected by heat as to become of sufficient fluidity to move in a continuous stream of even consistency from one vessel to another, by pouring or pumping, because butter can not be "clarified or refined" unless it be melted to that degree.

(*c*) The butter must, besides melting, have been subjected to some process by which it is "clarified or refined." Butter, or melted butter, may be clarified or refined by skimming, settling, aerating, washing, and other processes, through the action of heat, cold, agitation or motion, or rest.

(*d*) Butter thus melted and clarified or refined becomes an oil or fat almost free from taste and odor. To be again "made to resemble genuine butter" it must have restored to it the butter characteristics or similitude of texture, granulation, and flavor. For this purpose the processed or renovated butter is usually granulated by cooling, and churned, or otherwise mixed with milk or skim milk, or buttermilk, or cream, sweet or sour. It may or may not have common salt or artificial coloring added. To "resemble genuine butter" the article must have passed through these or other processes, subsequent to melting, so that it looks, smells, and tastes like "butter," having a similar appearance, consistency, texture, and flavor.

(*e*) It may be assumed that the object of subjecting a lot or lots of butter to such a process is to remove rancidity, sourness, mold, or other fault or feature which has impaired its merchantable quality, or to otherwise renew or improve the product so that the substance is truly "renovated," although such object is not expressed in the act.

(*f*) But if, in such process, "or in any (other) way," "any acid, alkali, chemical, or any substance whatever is introduced," or used, or if "there is mixed (therewith) any substance foreign to butter" (including any fat or oil other than butter fat), or if in any way the substance is made to hold "abnormal quantities of water, milk, or cream," the substance or commodity is to be recognized and treated as "adulterated butter" under this act.

(*g*) Renovated butter having 16 per cent or more of moisture will be held to contain "abnormal quantities of water, milk, or cream," and be, therefore, classed as "adulterated butter."

3. Section 4 of the act of May 9, 1902: "Manufacturers of process or renovated butter shall pay fifty dollars per year. * * * Every person who engages in the production of process or renovated butter * * * as a business shall be considered a manufacturer thereof." The special-tax year begins July 1. The special tax of manufacturers who commence business in the month of July will be reckoned for one year, and the tax of manufacturers who commence business after the month of July will be reckoned proportionately from the first day of the month from which the liability to special tax commenced to the 1st day of July following.

4. Every manufacturer of renovated butter, before commencing business (or at least within the month in which liability to special tax commenced), must register with the collector of the district in which the business is to be carried on, his name, or style, place of residence, business, and the place where such business is to be carried on, and procure a special-tax stamp at the rate of $50 per annum, which stamp he is to place and keep conspicuously posted in his establishment or place of business; and on the 1st day of July in each year he will again so register and procure a new special-tax stamp and post it as above stated.

5. Under the provisions of section 4 of said act the tax of one-fourth of 1 per cent per pound imposed thereby on renovated butter is to be represented by coupon stamps, to be provided by the Commissioner of Internal Revenue as authorized by existing laws. A fractional part of a pound shall be taxed as a pound.

6. For this purpose tax-paid stamps will be furnished in denominations of 10, 20, 30, 40, 50, 60, and 100 pounds, each stamp bearing nine coupons. Such stamps must contain the name of the collector, his district and State, and show thereon the date of payment of the tax, the number of pounds, and the number of the factory.

7. On the withdrawal of a package of renovated butter, the proper tax-paid stamp must be affixed thereto by the manufacturer, by the use of adhesive material, and if the packages be of wood not less than five tacks must be driven through

each stamp. The stamp when so affixed must be immediately canceled. For the purpose of cancellation the manufacturer will use a stencil plate or rubber stamp by which there shall be printed five parallel waved lines long enough to extend beyond each side of the stamp onto the package.

The printing on the stamp must be plain and distinct, and the waved lines must be fine enough to avoid obliterating the reading matter and figures contained in the tax-paid stamp. The imprinting must be with blacking or other durable coloring material, over and across the stamp, and in such manner as not to deface the stamp—that is, so as not to daub and make it illegible.

8. The stamp must be affixed to the side of the package, to a smooth surface in such a manner as to be readily canceled in the manner above described. When a package contains a number of pounds between 10 and 20, a *ten*-pound stamp with the necessary number of coupons attached will be issued to cover the net weight. Packages containing more than 20 pounds and less than 30 pounds will have attached a *twenty*-pound stamp with a suitable number of coupons to represent the contents. Larger sized packages will be similarly stamped.

9. Every manufacturer of renovated butter will be required to file with the collector a notice on Form No. 507, together with an inventory (Form No. 509) when making application for special-tax stamp as manufacturer. At the same time he will file a bond (Form No. 508) in a penal sum to be fixed by the collector of internal revenue for his district, but in no case less than $500.

Collectors of internal revenue will decline to approve the bond of a manufacturer of renovated butter until satisfied that the premises to be used for the manufacture of that article are entirely separate from those used for the manufacture of adulterated butter or oleomargarine, or for the handling or manipulation of butter not taxable under the act of May 9, 1902.

10. Each manufacturer of renovated butter is required to keep books and make returns showing the quantity of materials received on the factory premises, and the quantity of finished materials removed therefrom. Sample pages of book (Form No. 511) to be kept by manufacturers will be furnished to collectors, but the book must be provided by the manufacturer, as the same is not supplied by the Government.

11. Form No. 499 has been prescribed for monthly returns of manufacturers of renovated butter, and such forms will be furnished through the collectors of internal revenue.

12. Collectors will give to each manufacturer of renovated butter in their respective districts a factory number, the numbers to be consecutive and not thereafter changed. The factory number applies to the manufacturer and his establishment rather than to the building.

13. Every manufacturer of renovated butter shall place and keep on the side or end of the building wherein his business is carried on, so that it can be distinctly seen, a sign, with letters thereon not less than 3 inches in length, printed in oil colors or gilded, giving his full name and business and the number of his factory, as follows:

A——— B———,

MANUFACTURER OF RENOVATED BUTTER.

Factory No. ——.

14. Whenever any manufacturer's package of renovated butter is empty it will be the duty of the person who removes the contents thereof to destroy utterly the tax-paid stamp on such empty package. Any person having in his possession empty renovated-butter packages from which the tax-paid stamps have not been removed will be liable to a heavy penalty.

On the 6th day of October, 1902, the following ruling was made by the Commissioner of Internal Revenue:

"It is now held that original packages of oleomargarine or renovated butter may be shipped from the manufactory or place of business of the wholesale dealer securely covered in such a manner as to protect the contents from injury, provided the words 'Oleomargarine' or 'Renovated Butter,' as the case may be, are plainly marked or stenciled on the outside of such wrapper or covering, on two sides thereof, opposite each other, in gothic letters not less than one-half inch square, and so placed as to be plainly visible and easily read.

"It must be understood that the use of such covering is permitted for the purpose only of protecting the packages and contents from injury while in transit, and the same should not be allowed to remain on the packages after they have reached their destination, or when in the hands of the retail dealer. Neither will storage in warehouses of stamped packages thus covered be permitted, but the covering, whatever it is, shall be placed on the packages at the time of shipment and no longer in advance thereof than actually necessary.

"It shall be further understood that authority to ship original packages with the stamps, marks, and brands concealed will in no manner abridge the right of internal-revenue officers to examine such packages for the purpose of inspecting the stamps, marks, and brands thereon, or making other investigations.

"The authority here given is merely experimental and will be withdrawn immediately upon evidence appearing that the concession is made use of for the purpose of evading the law or the deception of the public or the officers of internal revenue."

15. Section 5 of said act of May 9, 1902, requires that all renovated butter and the packages containing the same shall be marked with the words "Renovated Butter," or "Process Butter," and by such other marks, labels, or brands and in such manner as may be prescribed by the Secretary of Agriculture. To carry this provision into effect the Secretary of Agriculture prescribes the following rules for labeling, marking, and branding.

16. Every manufacturer's package of renovated butter shall have affixed thereto a label, on which shall be printed the number of the factory and the revenue district and State in which it is located, together with the following notice:

MANUFACTURER'S DECLARATION AND NOTICE.

Factory No. ——, —— *district, State of* ————.

"The manufacturer of the RENOVATED BUTTER [a] (or process butter) herein contained has complied with all the requirements of the law and regulations authorized thereby. Every person is cautioned not to use again either this package or the stamp tax thereon, nor to remove the contents of this package without destroying said stamp, nor to remove, alter, or deface this notice or any of the required marks in connection herewith, under penalty provided by law in such cases."

This label or notice shall be printed in black, upon white paper, and shall be not less than 5, nor more than 7 inches long, and not less than 3 inches in width. The label must be securely affixed by paste to the side of the package and opposite or on a different side (not the top or bottom) from that to which the tax stamp is attached, and in such a way as to be exposed to view and easily read. After being affixed, this label must be covered with a coating of transparent and waterproof varnish or similar substance. The words "Renovated Butter" in this

[a] See size and style required for these two words at this place on page 16, Nos. 2 and 3.

notice must be printed in one or two lines and in plain gothic letters at least three-eighths inch square. There must also be plainly marked or stenciled on the outside of every package the gross, tare, and net weight in pounds.

17. All renovated butter may be packed by the manufacturer thereof in firkins, tubs, or packages, of wood or other suitable material not before used for that purpose; but each package must contain not less than 10 pounds; and when packed in a solid body or mass there shall be stamped or branded into the upper surface of the butter the words "Renovated Butter" in one or two lines, the letters to be gothic style, not less than one-half inch square and depressed not less than one-eighth inch.

18. Manufacturers will be permitted to pack prints, bricks, or rolls of renovated butter not less than 1 pound each in weight; but each print, brick, or roll must have stamped thereon the words "Renovated Butter" in two lines, the letters to be depressed, of gothic style, not less than three-eighths inch square and sunken not less than one-eighth inch. The contents of any package less than 10 pounds will be considered as a brick or roll.

19. Prints, bricks, or rolls as provided by rule 18 may be packed in manufacturers' stamped packages with or without coverings, wrappers, or inner packages of paper, cloth, wood, or other material; but every cover or wrapper of every description must have the words "Renovated Butter" in two lines, conspicuously marked, branded, stamped, or printed thereon in black, full-faced gothic letters not less than three-eighths inch square and so placed as to be the only marking upon one side or surface of the inner parcel as packed. Upon wrappers usual for prints or rolls this marking must be placed by itself near the middle of the wrapper, and the latter so used that the designated name will be the most conspicuous marking upon the outside of the wrapped print or roll when removed from the stamped package.

20. If manufacturers of renovated butter desire to place upon the outside of their original package as above described, or upon any inner package, wrapper, or cover, their names or the name of their establishment, or any words or marks descriptive of the product, or any character, sign, or trade-mark, this may be done provided the following conditions are strictly observed. Such additional markings must not cover, obscure, or be made more prominent than any of the stamps, marks, or labels otherwise required. For example:

JOHN DOE, Manufacturer of RENOVATED BUTTER, 20 1-lb. Plain Bricks. Extra Quality.	ARIZONA BUTTER COMPANY, Manufacturers of GOLDEN GRAIN BRAND RENOVATED BUTTER, 5-lb. Boxes, Solid Packed.

When so marked, the words "Renovated Butter" must be included in the brand, stencil, or mark in plain capital letters, not less in size than the letters used for the manufacturers' name, or that of his establishment, or for his trademark or special brand. And no other words, letters, or figures used in such additional markings shall be greater than one-half the size of the letters used for the words "Renovated Butter." And no character, device, or trade-mark shall occupy more space in such marking than is occupied by the word "butter" as prescribed in rule 19. All such additional markings, including wrappers of all kinds, should be submitted to the Secretary of Agriculture for examination and approval before being used.

21. Whenever referred to by the additional markings allowed by rule 20, or otherwise, the contents of the package or inner package or wrapper shall always be designated "Renovated Butter," and the word "butter" shall nowhere

appear or be used in markings without being immediately preceded by and having joined therewith the qualifying word "renovated," in the same type, letters, or characters, excepting that the manufacturer may use the words "Process Butter," provided they be in addition to (but not in place of) the words "renovated butter," and in no way more conspicuous. No incorrect or misleading word or sign shall be included in any part of the markings; for example, the words "creamery" and "dairy" must not be used. To repeat, the article in question must be referred to, named, and marked "Renovated Butter," always and only so, as prescribed by law and by these regulations, with the single exception above noted.

22. The law neither defines nor imposes special taxes upon wholesale or retail dealers in renovated butter. Neither does it describe the manner of sale of such product by dealers. However, renovated butter should always bear or be accompanied by the evidence that the manufacturer's tax thereon has been paid. Therefore it should not be removed or separated from the original package bearing the tax stamp and other prescribed marks when it is in transportation, the subject of interstate commerce, exported, or whenever and wherever offered for sale until delivered to the consumer or purchaser in retail trade. And dealers, as well as all other persons, should note the special and heavy penalties prescribed by law for removing, altering, or defacing *any* of the marks placed upon renovated butter, its wrappings, packages, etc., pursuant to law and regulations, except as provided in rule 14 of this series. Renovated butter can not be removed from manufacturers' packages and made into prints or any other form, and repacked in the same package, or any other, by dealers or any other persons anywhere without violation of the laws referred to in the first clause of section 5 of the act of May 9, 1902, and thereby made applicable to renovated butter.

23. Attention is called to the fact that the act named makes no provision for the exportation, free of tax, of renovated butter; nor for drawback of tax on such articles when exported. Consequently all renovated butter for export must be stamped and marked the same as for the domestic market.

24. All factories where renovated butter is manufactured, packed, or prepared for market, as well as the materials used and to be used, the processes, and the products, will be inspected from time to time by officers or agents specially designated for that purpose by the Secretary of Agriculture. Inspectors will be required to report upon "the character and condition of the material" and "the quantity and quality" of the product in such manner as may be prescribed.

25. Correspondence and all administrative details under the rules numbered 3 to 14, inclusive, above, are assigned to the Commissioner of Internal Revenue, Treasury Department. And similarly, all matters under the rules 15 to 24, inclusive, are assigned to the Dairy Division, Bureau of Animal Industry, Department of Agriculture.

Approved:

L. M. SHAW,
Secretary of the Treasury.

JAMES WILSON,
Secretary of Agriculture.

EXTRACTS REGARDING ADULTERATED BUTTER.

The following extracts from the Treasury Regulations refer mainly to adulterated butter. (In explanation of the first part of section 4, act of May 9, 1902):

The evident intent of this section is to define all products properly known or designated as butter, and to separate them into three classes for the purposes of the act. The first paragraph of the section adopts the definition of "butter" used in the act of August 2, 1886, as being "The food product usually known as butter, which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter."

All butter which does not come under the terms of this definition, therefore, necessarily falls into one of the other two classes, upon which a tax is laid.

The next paragraph of the section defines "adulterated butter," the product which bears the higher rate of tax, in a long clause, which is evidently intended to describe with some particularity well-defined forms of adulteration as examples or guides.

Such are, first, "A grade of butter produced by mixing, reworking, rechurning in milk or cream, refining, or in any way producing a uniform, purified, or improved product from different lots or parcels of melted or unmelted butter or butter fat, in which any acid, alkali, chemical, or any substance whatever is introduced or used for the purpose or with the effect of deodorizing or removing therefrom rancidity;" or, second, "Any butter or butter fat with which there is mixed any substance foreign to butter as herein defined, with intent or effect of cheapening in cost the product or any butter in the manufacture or manipulation of which any process or material is used with intent or effect of causing the absorption of abnormal quantities of water, milk, or cream."

Briefly stated, the first instance describes reworked or renovated butter to which a foreign substance has been added to "deodorize or remove rancidity;" the second instance describes butter cheapened in cost by admixtures or made to "contain abnormal quantities of water," etc.

The third paragraph of the section defines "process butter" or "renovated butter" essentially as butter which has been subjected to the processes generally used for the renovation of butter, but *without* the introduction or use of "any acid, alkali, chemical, or any substance whatever," and without being made to contain "abnormal quantities of water, milk, or cream."

It follows, therefore, that "renovated butter" is butter as defined in the law of August 2, 1886, containing nothing foreign to that product, but which, having become impaired in quality, has been subjected to melting and other renovating processes.

Section 4 of said act of May 9, 1902, further provides:

"That all adulterated butter shall be packed by the manufacturer thereof in firkins, tubs, or other wooden packages not before used for that purpose, each containing not less than ten pounds, and marked, stamped, and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe; and all sales made by manufacturers of adulterated butter shall be in original stamped packages.

"Dealers in adulterated butter must sell only original or from original stamped packages, and when such original stamped packages are broken the adulterated butter sold from same shall be placed in suitable wooden or paper packages, which shall be marked and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe. Every person who knowingly sells or offers for sale, or delivers or offers to deliver, any adulterated butter in any other form than in new wooden or paper packages, as above described, or who packs in any package any adulterated butter in any manner contrary to law, or who falsely brands any package or affixes a stamp on any package denoting a less amount of tax than that required by law, shall be fined for each offense not more than one thousand dollars and be imprisoned not more than two years."

Section 6 of said act of May 9, 1902, also provides:

"That wholesale dealers in oleomargarine, process, renovated, or adulterated butter shall keep such books and render such returns in relation thereto as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may, by regulation, require; and such books shall be open at all times to the inspection of any internal-revenue officer or agent. And any person who

wilfully violates any of the provisions of this section shall for each such offense be fined not less than fifty dollars and not exceeding five hundred dollars and imprisonment not less than thirty days nor more than six months."

NOTE.—The complete regulations regarding "adulterated butter," as well as those for oleomargarine, may be obtained from the office of the Commissioner of Internal Revenue, Treasury Department, Washington, D. C.

SUPPLEMENTAL NOTICES AND INSTRUCTIONS.

In addition to the foregoing, all persons concerned should note that besides the penalties prescribed in the internal-revenue laws relating to special taxes and tax stamps, there are specific penalties named in the last sentence of section 5 of the act of May 9, 1902 (see page 4), for violation of the provisions in that section for shipping and transporting "from its place of manufacture into any other State or Territory or the District of Columbia, or to any foreign country," renovated butter which has not been marked and prepared in all respects in accordance with the foregoing "needful regulations" duly made for carrying the said law into effect. And there are also specific penalties named in the acts of Congress referred to in the first sentence of said section 5, and which are thereby made applicable to renovated butter, for altering or destroying any marks placed thereon pursuant to law and regulations, or, in other words, for the violation of Rule 22, on page 10.

Samples of markings for wrappers, as provided by Rules 20 and 21, and of the words "renovated butter," as required by Rules 16, 17, 18, and 19, will be found on the following pages.

All inspectors, officers, or agents of the Department of Agriculture assigned to duty under this order, or the order of this Office dated October 31, 1901 (B. A. I. Order No. 91), will report promptly to the Secretary of Agriculture all violations of these regulations observed by them and all cases of failure fully to conform to the laws herein specified and the rules prescribed for their enforcement. Also, any case in which butter claimed to be "renovated" is believed to be "adulterated butter," in accordance with the legal definition thereof.

All inspectors, officers, or agents of the Department of Agriculture will at all times render every possible assistance to officers and agents of the Commissioner of Internal Revenue, Treasury Department, in the discharge of their duty under the act of May 9, 1902.

Instructions will be issued to agents of this Department from time to time regarding the inspection of factories, routes of transportation, and markets, and the reports to be rendered thereon. All such reports will be addressed to Dr. D. E. Salmon, Chief of the Bureau of Animal Industry.

JAMES WILSON, *Secretary.*

FURTHER INFORMATION CONCERNING WRAPPERS FOR RENOVATED BUTTER PACKED IN PRINT FORM.

ITEMS OF REQUIREMENTS OF THE REGULATIONS AS TO WRAPPERS, ABSTRACTED FROM THE REGULATIONS AND REARRANGED.

I. Under Rule 19.—Marking required in all cases.

1. To be marked with the words "renovated butter."
2. These words in two lines.
3. Printed in black.
4. In full-faced Gothic letters.
5. Letters not less than three-eighths of an inch square.
6. "This marking must be placed by itself."

7. To be "near the middle of the wrapper."
8. "To be the only marking on one side or surface."
9. To be "the most conspicuous marking upon the outside of the wrapped print or roll." (Should be the "top" or "front.")

II. Under Rule 20.—"Additional markings" are optional.

10. "Additional markings must not cover, obscure, or be more prominent than" the marking described above.
11. "The words 'renovated butter' must be included" in the "additional markings." This provision is intended particularly for outside or general package markings, but it also applies to wrappers when these bear the names of manufacturers or of their establishments "or any words or marks descriptive of the product." (See No. 14, below.)
12. Said words must be "in plain capital letters, not less in size than the letters used for the manufacturer's name or that of his establishment, or for his trade-mark or special brand." (The size and style of letters are limited only by these comparative conditions.)
13. "No other words, letters, or figures" in additional wrapper markings shall be greater than one-half the size of the letters used for the words "renovated butter," that is, as used in this same or "additional" part of the markings.
14. "No character, device, or trade-mark (in words or otherwise) shall occupy more space" than "BUTTER" in three-eighths inch type. This is approximately 1½ square inches of surface. The Secretary of Agriculture rules that such a brand or trade-mark, the latter limited to one or two words, may be used on any wrapper, if placed by itself and so as to be the only marking upon a side or surface of the print as packed, adjacent or at a right-angle to the one marked as required by Rule 19.
15. Borders, rectangular, circular, or of any shape, inclosing words alone, or a device or design, will not be included in the surface measure of a brand or trade-mark, unless claimed as a part thereof.

III. Under Rule 21.—Special provisions and prohibitions.

16. The words "creamery" and "dairy" must not be used on wrappers as referring to the contents.
17. The word "butter" must not be used alone as referring to the contents, but only "renovated butter" or "process butter."
18. The words "process butter" may be used "in addition to but not in place of the words renovated butter."
19. The words "process butter," if used, must be no more conspicuous than the words "renovated butter," as already described.
20. "No incorrect or misleading word or sign shall be included in any part of the markings" or wrapper.
21. All markings for wrappers in addition to the two words as first above described, "should be submitted to the Secretary of Agriculture (by mail directly or through an inspector) * * * before being used."

NOTES.—*a* The specifications above are not new rules, but authorized interpretations and explanations of the three rules named. These explanations relate to wrappers for prints, but they apply also to markings on the outsides of cartons and other coverings and packages, subject (for such purposes) to some modifications, under Rule 20.

b Upon the following pages are samples or models for forms of the printing on wrappers for renovated butter, showing approved arrangement of matter, relative size of type, etc.

FINEST FLAVOR IN THE AMERICAN MARKET

Packed in One Pound Fancy Prints

TROPHY BRAND

RENOVATED BUTTER

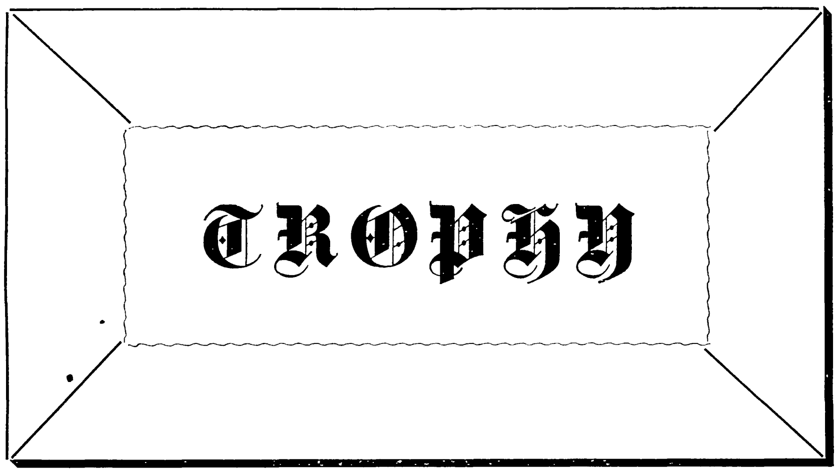
Always Uniform ——— Fresh ——— Full Weight

Made by the Most Improved new Process

LOS PINOS DAIRY CO., ARIZONA

RENOVATED BUTTER

Middle line -- **of wrapper.**



GUARANTEED ONE POUND FULL WEIGHT

RENOVATED BUTTER

Gilt Edge

Prepared Expressly for Family Use

AND ABSOLUTELY PURE.

Middle line -- **of wrapper.**

RENOVATED BUTTER

Note.—Supposing the wrapper to be divided into four folds or parts, the markings as above occupy the two mid parts.

Note for page 14 [of order], opposite.

Supposing the wrapper divided into four folds or parts, the markings thus occupy the two mid parts and the upper part. Either the upper-part marking or the lower mid-part marking, or both, may be omitted. Or, the upper-part marking may be replaced by the simple brand "Trophy," thus occupying only the upper and upper-middle parts.

SAMPLE OF FULL-FACED GOTHIC LETTERS.

One-half inch square.

No. 1.

RENOVATED

BUTTER

Three-eighths inch square.

No. 2.

RENOVATED BUTTER

No. 3.

RENOVATED

BUTTER

[B. A. I. ORDER NO. 99.]

Quarantine of Cattle, Sheep, and other Ruminants, and Swine in the New England States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., November 27, 1902.

To the managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In accordance with section 7 of the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and the act of Congress approved June 3, 1902, making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1903, you are hereby notified that the contagious disease known as foot-and-mouth disease exists among animals in the States of Connecticut, Rhode Island, Massachusetts, and Vermont, and that the cattle, sheep, and other ruminants, and swine of said States have been exposed to the contagion of said disease: Therefore,

It is hereby ordered, That, to prevent the spread of the said disease from the States of Connecticut, Rhode Island, Massachusetts, and Vermont into other States or foreign countries, and to aid in its eradication, no cattle, sheep, or other ruminants, or swine shall be moved or be permitted to move from or across the territory of any one of the States above named into any other State or foreign country. Any person, company, or corporation violating this order will be proceeded against as provided for by the act of Congress above referred to.

It is hoped that all transportation companies, cattle shippers, and others interested in the welfare of our animal industry will cooperate with the Department of Agriculture in enforcing this order, to the end that the restriction on traffic may have the desired effect and be removed in the shortest possible time.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 1 TO B. A. I. ORDER NO. 99.]

Quarantine of Cattle, Sheep, and other Ruminants, and Swine in the New England States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., November 29, 1902.

It is hereby ordered, That the order of November 27, 1902 (B. A. I. Order No. 99), prohibiting the movement of cattle, sheep, or other ruminants, or swine from or across either of the States of Connecticut, Rhode Island, Massachusetts, or Vermont, into any other State or foreign country, be modified so that said animals may be shipped from points outside of said States into or across the quarantined territory for the purpose of immediate slaughter, provided they are shipped in cars sealed by inspectors of the Department of Agriculture and that they are not unloaded while within said territory except at their place of destination for slaughter. The seals on the cars carrying said animals shall not be broken except at their destination, and the movement of the animals shall be so arranged that the time of their confinement in the cars shall not exceed the limit fixed by law.

J. H. BRIGHAM, *Acting Secretary.*

[AMENDMENT NO. 2 TO B. A. I. ORDER NO. 99.]

Quarantine of Cattle, Sheep, and other Ruminants, and Swine in the New England States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 13, 1902.

It is hereby ordered, That the order of November 27, 1902 (B. A. I. Order No. 99), prohibiting the movement of cattle, sheep, or other ruminants, or swine from or across either of the States of Connecticut, Rhode Island, Massachusetts, or Vermont, into any other State or foreign country, be amended by the addition of the following paragraphs:

That all cars which have carried animals within the limits of either of said States shall be cleaned and disinfected before leaving said State. That all cars which have carried animals from points outside of the quarantined territory into either of said States, as provided for immediate slaughter, shall likewise be cleaned and disinfected: *Provided,* That where there are no facilities for disinfection or when the condition of the weather prevents its proper accomplishment, such cars may be allowed to go out without disinfection if they are sealed at the time of unloading by an inspector of this Department, and said seal is not broken until after arrival in uninfected territory.

The cleaning and disinfection shall be done in the following manner: First, clean the car thoroughly; then the entire interior surface of the car is to be thoroughly washed with a mixture made of 1½ pounds of lime and 7 ounces of 100 per cent carbolic acid to each gallon of water, or of the same quantity of lime with 7 ounces of chloride of lime to each gallon of water. If the work is supervised by an inspector of this Department, instead of using the foregoing mixtures, the disinfection may be done with a jet of steam under a pressure of not less than 50 pounds to the square inch. The litter and manure taken from cars that have carried animals within the limits of said States shall be disinfected by mixing them with lime or saturating them with a 5 per cent solution of 100 per cent carbolic acid.

That the hides, skins, hair, horns, or hoofs of ruminants or swine shall not be allowed to be taken out of either of the said quarantined States: *Provided,* That such articles imported at any port in said States where an inspector of this Department is stationed may be forwarded under certificate of said inspector.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 3 TO B. A. I. ORDER NO. 99.]

Quarantine of Cattle, Sheep, and other Ruminants, and Swine in the New England States—Removal of Quarantine from Connecticut.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 22, 1902.

Whereas, Careful investigation and searching inquiry have failed to demonstrate a case of foot-and-mouth disease in Connecticut, and have shown that animals in said State may be moved without restriction in consequence of their freedom from said disease,

It is hereby ordered, That the State of Connecticut be excepted from the operation of the order of November 27, 1902 (B. A. I. Order No. 99), and amendments thereto, and that the restrictions imposed by said order and amendments upon the movement of ruminants and swine, their hides, skins, hair, horns, or hoofs, and upon stock cars from, into, or across said State be removed.

JAMES WILSON, *Secretary.*

[B. A. I. ORDER No. 100.]

Prohibition of the Exportation of Cattle, Sheep, and other Ruminants, and Swine from the Port of Boston.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., November 27, 1902.

Whereas, A highly contagious disease, known as foot-and-mouth disease, exists among cattle in the State of Massachusetts, and the routes of transportation possibly may have been contaminated, and in order to protect the export trade in live animals by preventing the exportation of animals which are diseased or which have been exposed to disease,

It is hereby ordered, That no cattle, sheep, or other ruminants, or swine shall be permitted to be exported from the port of Boston until further orders.

JAMES WILSON, *Secretary.*

[B. A. I. ORDER No. 101.]

Regulations Concerning Cattle Transportation.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 26, 1902.

To managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In accordance with section 7 of the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and of the act of Congress approved June 3, 1902, making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1903, you are hereby notified that a contagious and infectious disease known as splenetic, Southern, or Texas fever exists among cattle in the following-described area:

"1. All that country lying south or below a line beginning at the northwest corner of the State of California; thence east, south, and southeasterly along the boundary line of said State of California to the southeastern corner of said State; thence southerly along the western boundary line of Arizona to the southwest corner of Arizona; thence along the southern boundary lines of Arizona and New Mexico to the southeastern corner of New Mexico; thence northerly along the eastern boundary of New Mexico to the southern line of the State of Colorado; thence along the southern boundary lines of Colorado and Kansas to the southeastern corner of Kansas; thence southerly along the western boundary line of Missouri to the southwestern corner of Missouri; thence easterly along the southern boundary line of Missouri to the western boundary line of Dunklin County; thence southerly along the said western boundary to the southwestern corner of Dunklin County; thence easterly along the southern boundary line of Missouri to the Mississippi River; thence northerly along the Mississippi River to the northern boundary line of Tennessee at the northwest corner of Lake County; thence easterly along said boundary line to the northeast corner of Henry County; thence in a northerly direction along the boundary of Tennessee to the northwest corner of Stewart County; thence in an easterly direction along the northern boundary of Tennessee to the southwestern corner of Virginia; thence northeasterly along the western boundary line of Virginia to the northernmost point of Virginia; thence

southerly along the eastern boundary line of Virginia to the northeast corner of Virginia, where it joins the southeastern corner of Maryland at the Atlantic Ocean.

"2. Whenever any State or Territory located above or below said quarantine line, as above designated, shall duly establish a different quarantine line and obtain the necessary legislation to enforce said last-mentioned line strictly and completely within the boundaries of said State or Territory, and said last above-mentioned line and the measures taken to enforce it are satisfactory to the Secretary of Agriculture, he may, by a special order, temporarily adopt said State or Territorial line.

"Said adoption will apply only to that portion of said line specified, and may cease at any time the Secretary may deem it best for the interests involved, and in no instance shall said modification exist longer than the period specified in said special order; and at the expiration of such time said quarantine line shall revert without further order to the line first-above described.

"Whenever any State or Territory shall establish a quarantine line for above purposes differently located from the above-described line, and shall obtain by legislation the necessary laws to enforce the same completely and strictly, and shall desire a modification of the Federal quarantine line to agree with such State or Territorial line, the proper authorities of such State or Territory shall forward to the Secretary of Agriculture a true map or description of such line and a copy of the laws for enforcement of same, duly authenticated and certified.

"3. From the 1st day of January, 1903, no cattle are to be transported from said area south or below said Federal quarantine line above described to any portion of the United States above—north, east, or west of—the above-described line, except as hereinafter provided.

"4. Cattle from said area may be transported by rail or boat for immediate slaughter, and when so transported the following regulations must be observed:

"(*a*) When any cattle in course of transportation from said area are unloaded above—north, east, or west of—this line to be fed or watered, or for other purposes, said cattle shall be placed in pens or yards set apart for infected cattle and no other cattle shall be admitted thereto.

"(*b*) On unloading said cattle at their points of destination chutes, alleyways, and pens, sufficiently isolated, shall be set apart to receive them, and no other cattle shall be admitted to said chutes, pens, and alleyways; and the regulations relating to the movement of cattle from said area, prescribed by the cattle sanitary officers of the State where unloaded, shall be carefully observed. The cars or boats that have carried said stock shall be cleansed and disinfected as soon as possible after unloading and before they are again used to transport, store, or shelter animals or merchandise.

"(*c*) All cars carrying cattle from said area shall bear on both sides printed placards, the letters of which shall be plain and not less than 1½ inches in height, to be affixed by the railroad company hauling the same, stating that said cars contain Southern cattle; and each of the waybills, conductor's manifests, and bills of lading of said shipments by cars or boats shall have a note plainly written or stamped upon its face with a similar statement. The placards shall state the name of the place from which the shipment was made, with the date and the name of the place of destination; said date must correspond with the date of the waybill and other papers. Whenever any cattle have come from said area and shall be reshipped from any point at which they have been unloaded to other points of destination the cars carrying said animals shall bear on both sides similar placards with like statements, and the waybills, conductor's manifests, or bills of lading be so stamped. At whatever point these cattle are unloaded they must be placed in separate pens, to which no other cattle shall be admitted.

"(*d*) No boat having on board cattle from said district shall receive on board cattle from outside of said district. Cattle from said district shall not be received on board when destined to points outside of said district where proper facilities have not been provided for transferring the said cattle from the landing to the stock yards and slaughterhouses without passing over public highways, unless permission for such passing is first obtained from the local authorities.

"(*e*) The cars and boats used to transport such animals, the chutes, alleyways, and pens used during transportation and at points of destination, shall be disinfected in the following manner:

"Remove all litter and manure. This litter and manure may be disinfected by mixing it with lime or saturating it with a 5 per cent solution of 100 per cent carbolic acid, or, if not disinfected, it may be stored where no cattle can come in contact with it during the period from February 1 to November 15 of each year.

"Wash the cars and the feeding and watering troughs with water until clean.

"Saturate the entire interior surface of the cars and the fencing, troughs, chutes, and floors of the pens with a mixture made of 1½ pounds of lime and one-quarter pound of 100 per cent straw-colored carbolic acid to each gallon of water, or a solution made by dissolving 4 ounces of chloride of lime to each gallon of water may be used; or disinfect the cars with a jet of steam under a pressure of not less than 50 pounds to the square inch.

"5. Cattle from the Republic of Mexico may be admitted into the United States, after inspection according to law, as follows:

"Cattle free from splenetic, or Texas, fever, and from contact therewith during the six months preceding such inspection, and which have been grazed in a locality free from infection of such fever, may be admitted into any part of the United States. If destined to points in the noninfected area, a special permit must be obtained from an inspector of the Bureau of Animal Industry, said permit being issued according to the regulations of said Bureau. The cattle for which said permit is issued must not be driven through the infected area, nor be unloaded in any part thereof, except at such a point as may be duly designated by an order issued by this Department. If shipped in infected cars or unloaded in the infected area, except as above stated, they will be subject to the regulations concerning infectious cattle.

"6. Notice is hereby given that cattle infested with the *Boophilus annulatus* (*B. bovis*), or Southern cattle tick, disseminate the contagion of splenetic, Southern, or Texas, fever; therefore cattle originating outside of the district described by this order or amendments thereof, and which are infested with the *Boophilus annulatus* ticks, shall be considered as infectious cattle and shall be subject to the rules and regulations governing the movement of Southern cattle.

"7. Stock-yard companies receiving cattle infested with said ticks shall place such cattle in the pens set aside for the use of Southern cattle, and transportation companies are required to clean and disinfect all cars and boats which have contained the same, according to the requirements of this Department.

"8. Inspectors are instructed to see that disinfection is properly done, and to report instances of improper disinfection. It is expected that transportation and stock-yard companies will promptly put into operation the above methods."

B. A. I. Order No. 93 and amendments thereto are hereby revoked.

JAMES WILSON, *Secretary*.

[AMENDMENT NO. 1 TO B. A. I. ORDER NO. 101.]

Special Order Modifying Quarantine Line for the State of California—1903.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 27, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of California has agreed to establish and cooperate in the enforcement of a quarantine line located as follows:

"Beginning on the Pacific coast where the northern boundary line of Monterey County connects with the Pacific Ocean, thence easterly and southerly along the northern and eastern boundary line of Monterey County to its junction with the western boundary of Fresno County; thence northerly along the western boundary of Fresno County to the western corner thereof; thence northerly, easterly, and southerly along the western, northern, and eastern boundary line of Merced County to the southeast corner thereof, thence northeasterly along the northern boundary of Madera County to the northeast corner thereof; thence southerly and easterly along the eastern boundary lines of Madera, Fresno, and Tulare counties to the southeast corner of Tulare County; thence easterly along the southern boundary line of Inyo County to its intersection with the eastern boundary line of the State of California."

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of California to enforce said quarantine line, therefore the above quarantine line is adopted for the State of California by this Department for the period beginning on January 1, 1903, and ending December 31, 1903, in lieu of the quarantine line described in the order of December 26, 1902, for said area, unless otherwise ordered.

It is further ordered, That during the continuance of the above line no cattle originating in the quarantined area as described in B. A. I. Order No. 101, as modified, shall be moved or allowed to move into the counties of Kern, Tulare, Kings, Monterey, Fresno, Madera, and Merced; and that cattle now in said counties may be moved to points outside of the quarantined area for purposes other than immediate slaughter upon inspection and certification that they are free of infection by a duly authorized officer of the county board of supervisors, and that said certificate be approved and signed by the State veterinarian. This privilege is granted upon condition that the board of supervisors in each of said counties adopt and enforce efficient measures to prevent the introduction into and the dissemination within the county of the contagion of Southern cattle fever, and that it prosecute measures for the eradication of said disease.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 2 TO B. A. I. ORDER NO. 101.]

Special Order Modifying Quarantine Line for the State of Texas—1903.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 27, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of Texas has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning at the intersection of the southern boundary of New Mexico with the international boundary line at the Rio Grande River, thence southeasterly

along the said international boundary line to the southwest corner of the county of Pecos; thence following the western boundary of Pecos County to the southeast corner of Reeves County; thence following the boundary line between the counties of Pecos and Reeves to the Pecos River; thence southeasterly, following the Pecos River, to the northwest corner of Crockett County; thence east along the northern boundary of Crockett and Schleicher counties to the southeastern corner of Irion County; thence north along the eastern boundary of Irion County to the northeast corner of said county; thence continuing due north to the southern boundary line of Coke County; thence west with the southern boundary of Coke County to the southwest corner of Coke County; thence north along the western boundary of Coke County to the southern boundary of Mitchell County; thence east to the southeast corner of Mitchell County; thence north along the eastern boundary of Mitchell County to the northeast corner of said county; thence east along the southern boundaries of Fisher and Jones counties to the southeast corner of Jones County; thence north along the eastern boundary of Jones County to the northeast corner of said county; thence east along the southern boundary of Haskell County to the southeast corner of said county; thence north along the western boundary lines of Throckmorton and Baylor counties to the northwest corner of Baylor County; thence east along the southern boundary of Wilbarger County to the southeast corner of said county; thence north along the eastern boundary of Wilbarger County to the Red River; thence continuing in a northwesterly direction along the course of said river and the northern boundary of Texas to the southeast corner of Greer County, Okla."

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of Texas to enforce said quarantine line, therefore the above quarantine line is adopted for the State of Texas by this Department for the period beginning on January 1, 1903, and ending December 31, 1903, in lieu of the quarantine line described in the order of December 26, 1902, for said area, unless otherwise ordered.

It is further ordered, That during the continuance of the above line no cattle originating in the quarantined area as described in B. A. I. Order No. 101, as modified, shall be moved or allowed to move into the counties of Baylor and Throckmorton, and that portion of the county of Pecos lying north and west of the line described as follows: Beginning at the west line of Pecos County, at the point where the roadbed of the G. H. and S. A. Railroad crosses said line; thence in an easterly direction with the center of said roadbed to a point on section No. 36, Block A2, G. H. and S. A. Railroad Company; thence north with the pasture fence running in a northerly direction through the eastern part of sections Nos. 13 and 12 of said Block A2, and across section No. 1, G. C. and S. F. Railroad Company; thence continuing north with said pasture fence through the eastern part of sections Nos. 16, 17, 46, 47, 76, 77, 106, 107, 136, 137, 142, 143, and 194, Block D, M. K. and T. E. Railroad Company; thence continuing in a northerly direction to a point on the north line of section No. 6, Block 160, G. C. and S. F. Railroad Company, same being corner of pasture fence; thence east with the north line of sections Nos. 6, 9, 10, 11, 12, 15, 16, Block 160, G. C. and S. F. Railroad Company, to the northeast corner of said section No. 16, same being corner of pasture fence; thence in a northerly direction with the east boundary line of sections Nos. 22, 21, 20, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, Block 1, C. C. S. D. and R. G. N. G. Railroad Company, to the northeast corner of said section 32; thence west with the north boundary line of sections Nos. 32 and 33, same block, to the northwest corner of section No. 33, Block 1, C. C. S. D. and R. G. N. G. Railroad Company, corner of fence; thence north with the east boundary line of sections Nos. 1, 12, 13, 24, 25, 36, 37, 48, 49, 60, 61, and 72, Block 2, C. C. S. D. and R. G. N. G. Railroad Company, to the northeast corner of said section No. 72; thence in an easterly direc-

tion with the pasture fence to the southeast corner of section No. 9, patented to James E. Evans; thence north with the east line of said section No. 9 to the northwest corner of section No. 100, Block A2, T. C. Railroad Company; thence east with north boundary line of said sections Nos. 100 and 89, same block, to the northeast corner of said section No. 89, Block A2, T. C. Railroad Company; thence north with the east boundary line of sections Nos. 90, 91, 92, and 93 to the southeast corner of section No. 94, Block A2, T. C. Railroad Company; thence northwest diagonally across section No. 94 to the northwest corner of said section; thence continuing in a northwesterly direction, diagonally across sections Nos. 14, 18, and 28, to the northeast corner of section No. 29, Block C4, G. C. and S. F. Railroad Company; thence west with the north boundary line of said section No. 29 to the northwest corner of said section; thence northwest diagonally across section No. 1, T. C. Railroad Company, section No. 97, Block No. 194, G. C. and S. F. Railroad Company, to the northeast corner of said section No. 96; thence in a northerly direction across section No. 94 to a point on its north boundary line 600 varas west of its northeast corner; thence continuing north through sections Nos. 93, 90, 89, 86, 85, and 58, Block 194, G. C. and S. F. Railroad Company, to a point on the north boundary line of said section No. 58; thence northwesterly with the pasture fence, through section No. 59, to the northeast corner of section No. 82 and the southeast corner of section No. 81, same block; thence continuing northwesterly to section No. 17, H. and G. N. Railroad Company; thence north with the east line of said section 17 to the Pecos River; thence northwesterly with said Pecos River to the northwest corner of Crockett County.

And it is further ordered, That no cattle shall be moved or allowed to move from the counties of Cottle, Hardeman, Foard, Wilbarger, King, Knox, Haskell, Stonewall, Jones, Fisher, Scurry, Garza, Borden, Howard, Mitchell, Glasscock, Sterling, Irion, West Tom Green, Upton, Crane, Throckmorton, and Baylor, and that portion of the county of Pecos as described above, to any of that territory in the State of Texas lying west and north of said counties, except after having been inspected and found free of infection by duly authorized inspectors of this Department or of the State of Texas, and upon written permission by such officer. No cattle from said counties shall be moved or allowed to move to any State or Territory outside of the quarantined district (except as provided for immediate slaughter) unless they have been duly inspected and passed, and permit issued by inspectors of this Department, nor until permission has been obtained from the proper officials of the State or Territory to which said cattle are destined.

JAMES WILSON, *Secretary*.

[AMENDMENT NO. 3 TO B. A. I. ORDER NO. 101.]

Special Order Modifying Quarantine Line for the Territory of Oklahoma—1903.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 27, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the Territory of Oklahoma has agreed to establish and to cooperate in the enforcement of a quarantine line, located as follows:

"Beginning on the Red River at the southeastern corner of the county of Greer; thence northerly following the course of the North Fork of the Red River to its intersection with the southern boundary line of Roger Mills County, along the western boundary lines of the Apache, Comanche, and Kiowa Indian reservations; thence east along the southern boundary lines of Roger Mills and Washita

counties to the intersection with the boundary line of the Wichita Indian Reservation on the Washita River; thence north along the western boundary line of said reservation to its northwest corner at its intersection with the Canadian River in the county of G; thence in a southeasterly direction along the course of said river and the northern boundary of the Wichita Indian Reservation to the northeast corner of said reservation; thence easterly along the southern boundary of Canadian County to the southeast corner of said county; thence north along the eastern boundary line of Canadian County to the northwest corner of Cleveland County; thence east along the northern line of Cleveland County to the middle of the right of way of the Atchison, Topeka and Santa Fe Railway; thence northerly following the middle of said right of way through Oklahoma, Logan, Noble, and Payne counties, and the Otoe, Missouri, and Ponca Indian reservations to the northern boundary of the Ponca Indian Reservation; thence east along the northern boundary of the Ponca Indian Reservation to the Arkansas River; thence in a northerly direction following the course of the said river to its intersection with the thirty-seventh parallel of north latitude at the southern boundary line of Kansas."

And whereas said quarantine line as above set forth is satisfactory to this Department and legislation has been enacted by the Territory of Oklahoma to enforce said quarantine line, therefore the above quarantine line is adopted for the Territory of Oklahoma by this Department for the period beginning on January 1, 1903, and ending December 31, 1903, in lieu of the quarantine line described in the order of December 26, 1902, for said area, unless otherwise ordered.

It is further ordered, That, during the continuance of the above line, no cattle shall be moved or allowed to move from the counties of Greer, Roger Mills, Washita, Custer, Blaine, Canadian, and that part of the counties of Oklahoma, Logan, Payne, and Noble and of the Otoe, Missouri, and Ponca Indian reservations lying west of the right of way of the Atchison, Topeka and Santa Fe Railway, to any of that part of the Territory of Oklahoma lying west and north of said line, except after having been inspected and found free of infection by duly authorized inspectors of this Department or of the Territory of Oklahoma, and upon written permission by such officer, nor to any State or Territory outside of the quarantined district (except as provided for immediate slaughter), unless they have been duly inspected and passed and permit issued by inspectors of this Department, nor until permission has been obtained from the proper officials of the State or Territory to which destined.

JAMES WILSON, *Secretary*.

[AMENDMENT NO. 4 TO B. A. I. ORDER NO. 101.]

Special Order Modifying Quarantine Line for the State of Tennessee—1903.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 27, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of Tennessee has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning on the Mississippi River at the southeast corner of the State of Missouri at the western boundary of Tennessee; thence southerly along the western boundaries of the counties of Dyer and Lauderdale; thence following the main channel of the Mississippi River (leaving Island No. 37 to the north and west) to the northwestern corner of Shelby County on the Mississippi River; thence easterly along the northern boundary lines of Shelby and Fayette counties to the southwestern cor-

ner of Haywood County; thence northerly and easterly along the western and northern boundary lines of Haywood County to the northeastern corner of said county; thence easterly along the northern boundary line of Madison County to the southwest corner of Carroll County; thence northerly and easterly along the western and northern boundary lines of Carroll County to the northeast corner of said county; thence southerly along the eastern boundary of said county to its intersection with the Nashville, Chattanooga and St. Louis Railway; thence easterly along the middle of the roadbed of said railway through Benton County to the intersection of said Nashville, Chattanooga and St. Louis Railway with the Tennessee River at the eastern boundary of Benton County; thence south along the eastern boundaries of Benton and Decatur counties to the northwest corner of Wayne County; thence easterly along the northern boundary lines of Wayne and Lawrence counties to the northeastern corner of Lawrence County; thence south along the eastern boundary of Lawrence County to the southeast corner thereof; thence east along the southern boundary of Giles County to the Elk River; thence northeasterly along said river through Giles and Lincoln counties to the eastern boundary of Lincoln County; thence northerly and easterly along the western and northern boundaries of Moore County to the northeast corner of Moore County; thence north along the western boundary lines of Coffee and Cannon counties to the northwest corner of Cannon County; thence northeasterly and southeasterly along the northern and eastern boundaries of Cannon County to the boundary of Warren County; thence easterly along the northern boundary of Warren County to the western boundary of White County; thence northeasterly and southeasterly along the western and northern boundaries of White County to the western boundary of Cumberland County; thence southerly, easterly, and northeasterly along the western, southern, and eastern boundaries of Cumberland County to the northern corner of Rhea County; thence southerly along the eastern boundary lines of Rhea and James counties to the northwest corner of Bradley County; thence northerly and southeasterly along the northern boundary lines of Bradley and Polk counties to the northeast corner of Polk County; thence south along the eastern boundary line of Polk County to the southeast corner thereof at the southwestern corner of North Carolina."

That portion of the quarantine line for the State of Virginia, described in the order of December 27, 1902 (amendment No. 7 to B. A. I. Order No. 101), beginning at the southwestern corner of Virginia (Lee County) and extending east along the southern boundary line of Virginia to the southeastern corner of Washington County, is hereby suspended during the enforcement of the above line for the State of Tennessee.

And whereas said quarantine line as above set forth is satisfactory to this Department and legislation has been enacted by the State of Tennessee to enforce said quarantine line, therefore the above line is adopted for the State of Tennessee by this Department for the period beginning on January 1, 1903, and ending December 31, 1903, in lieu of the quarantine line described in the order of December 26, 1902, for said area, unless otherwise ordered.

It is further ordered, That, during the continuance of the above line, cattle now in the western and northern parts of Carroll County may be moved for purposes other than immediate slaughter to States and Territories outside of the quarantined area after being inspected and found free of infection by an inspector of this Department, and upon written permission by such officer.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 5 TO B. A. I. ORDER NO. 101.]

Special Order Modifying Quarantine Line for the State of Georgia—1903.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 27, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of Georgia has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning at the intersection of the western boundary line of Union County with the boundary line between the States of Georgia and North Carolina; thence southerly along the western boundary of Union County to the southwest corner thereof; thence northeasterly and easterly along the southern boundary lines of Union and Towns counties to the western corner of Rabun County; thence easterly, southeasterly, and northeasterly along the western, southern, and eastern boundaries of Rabun County to the northeast corner of said county on the boundary between Georgia and North Carolina."

That portion of the quarantine line for the State of North Carolina, described in the order of December 27, 1902 (amendment No. 6 to B. A. I. Order No. 101), beginning at the intersection of the northwest corner of Union County, Ga., with the State line, extending east along the southern boundary line of North Carolina to the northeast corner of Rabun County, is hereby suspended during the enforcement of the above line for the State of Georgia.

And whereas said quarantine line as above set forth is satisfactory to this Department and legislation has been enacted by the State of Georgia to enforce said quarantine line, therefore the above quarantine line is adopted for the State of Georgia by this Department for the period beginning on January 1, 1903, and ending December 31, 1903, in lieu of the quarantine line described in the order of December 26, 1902, for said area, unless otherwise ordered.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 6 TO B. A. I. ORDER NO. 101.]

Special Order Modifying Quarantine Line for the State of North Carolina—1903.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 27, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of North Carolina has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning at the southwest corner of the county of Cherokee; thence east along the southern boundary lines of the counties of Cherokee, Clay, Macon, Jackson, Transylvania, and Henderson to the southwest corner of the county of Polk; thence northerly along the western boundaries of Polk and Rutherford counties to the southern boundary of McDowell County; thence westerly, northerly, and northeasterly along the southern, western, and northern boundaries of McDowell County to the western boundary of Burke County; thence southerly along the western boundary line of Burke County to the Catawba River; thence easterly along the course of said river to the southwestern corner of Alexander County; thence north along the western boundary of said county to the southern boundary of Wilkes County; thence northwesterly along the boundary line of Wilkes County to the western corner of said county; thence following the western

and northern boundary line of Wilkes County to the western portion of Surry County; thence northeasterly along the western boundary line of Surry County to its intersection with the northern boundary line of the State of North Carolina."

That portion of the quarantine line for the State of Virginia, described in the order of December 27, 1902 (amendment No. 7 to B. A. I. Order No. 101), beginning at the southwestern corner of Grayson County and extending east along the southern boundary line of Virginia to the southeastern corner of said county, is hereby suspended during the enforcement of the above line for the State of North Carolina.

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of North Carolina to enforce said quarantine line, therefore the above quarantine line is adopted for the State of North Carolina by this Department for the period beginning on January 1, 1903, and ending December 31, 1903, in lieu of the quarantine line described in the order of December 26, 1902, for said area, unless otherwise ordered.

It is further ordered, That during the continuance of the above line no cattle originating in the quarantined district, as described in B. A. I. Order No. 101, as modified, shall be moved or allowed to move into the counties of Surry, Wilkes, McDowell, and that part of Burke south of the Catawba River.

And it is further ordered, That no cattle shall be moved or allowed to move from the counties of Surry, Wilkes, McDowell, and that part of Burke south of the Catawba River to any of that territory in the State of North Carolina lying west and north of said counties, except after having been inspected and found free of infection by duly authorized inspectors of this Department or of the State of North Carolina, and upon written permission by such officer. No cattle from said counties shall be moved or allowed to move to any State or Territory outside of the quarantined district (except as provided for immediate slaughter), unless they have been duly inspected and passed and permit issued by inspectors of this Department, nor until permission has been obtained from the proper officials of the State or Territory to which destined.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 7 TO B. A. I. ORDER NO. 101.]

Special Order Modifying Quarantine Line for the State of Virginia—1903.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 27, 1902.

In accordance with the regulations concerning cattle transportation issued by this Department, the State of Virginia has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

"Beginning at the boundary line of Virginia at its southwestern corner (Lee County); thence east along the southern boundary of Virginia to the southwestern corner of Patrick County; thence northerly along the western boundaries of Patrick and Franklin counties to Daniels Run; thence easterly along Daniels Run and the Blackwater River to the Staunton River; thence in a southeasterly and northeasterly direction along the southern and eastern boundaries of Bedford County to the James River; thence following the James River to the southeastern corner of Charles City County; thence northerly and easterly along the western and northern boundaries of James City County to the western boundary of Gloucester County at the York River; thence southerly and northerly along the southern and eastern boundaries of Gloucester County to the northeastern corner

of said county; thence easterly and southerly along the northern and eastern boundaries of Mathews County to the southeastern point of said county; thence south to the northern boundary of Elizabeth City County; thence westerly and northerly along the boundaries of Elizabeth City and Warwick counties to the James River; thence southeasterly along the course of the said river to the northwest corner of Norfolk County; thence south along the western boundary of said county to its intersection with the northern boundary of North Carolina; thence east along the southern boundaries of Norfolk and Princess Anne counties to the Atlantic Ocean."

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of Virginia to enforce said quarantine line therefore the above quarantine line is adopted for the State of Virginia by this Department for the period beginning on January 1, 1903, and ending December 31, 1903, in lieu of the quarantine line described in the order of December 26, 1902, for said area, unless otherwise ordered.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 8 TO B. A. I. ORDER NO. 101.]

Regulations Concerning Cattle Transportation—Feeding Stations in the Quarantined District for Uninfected Cattle.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 27, 1902.

It is hereby ordered, That cattle originating outside—north, east, and west of—the quarantined district, as defined in the order of December 26, 1902 (B. A. I. Order No. 101), and amendments thereto, and which are to be transported by rail through the quarantined district, may be unloaded for rest, feed, and water into uninfected pens set apart for such cattle at Polk Stock Yards and Union Stock Yards, Fort Worth, Tex.; Baird, Tex.; Southern Pacific Railway Stock Yards, Los Angeles, Cal.; Bakersfield, Cal., and at Salisbury, N. C.: *Provided,* That the cattle are free from Southern cattle ticks and have not been unloaded at any other place within the quarantined district. They may, after unloading into said pens, be reloaded into the same cars from which unloaded, or into other cleaned and disinfected cars, and reshipped as uninfected cattle.

JAMES WILSON, *Secretary.*

[AMENDMENT NO. 9 TO B. A. I. ORDER NO. 101.]

Regulations Concerning Cattle Transportation—Restrictions Modified During January, 1903.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 29, 1902.

It is hereby ordered, That section 3 of B. A. I. Order No. 101, dated December 26, 1902, providing for the movement of cattle from the quarantined district described by said order and amendments thereto, be amended as follows:

"From January 1 to January 31, 1903, inclusive, cattle from said district may be moved for purposes other than immediate slaughter to such points within the States of Virginia, North Carolina, Tennessee, Missouri, Kansas, and the Territories of New Mexico and Arizona, as may be provided for in the regulations of

these States and Territories and permitted by the local authorities in charge. In the absence of such local regulations and permission, all movement of cattle from the quarantined district to points outside of said district in above-named States and Territories is prohibited, except as provided for immediate slaughter. All cattle from the quarantined district destined to points outside of the States and Territories above named, except Texas and Oklahoma, may be shipped without inspection between January 1 and January 31, 1903, inclusive, and without restrictions other than may be enforced by local regulations at point of destination. The reshipment to any part or parts of the States of Virginia, North Carolina, Tennessee, Missouri, Kansas, and the Territories of New Mexico and Arizona, of any cattle which may have been moved under this order, except by permission of the proper authorities of the State or Territory to which destined, is hereby prohibited."

And it is further ordered, That all stock pens which may have been reserved for the use of cattle from the quarantined district shall not be used for receiving or storing cattle from the quarantined district which have been inspected and passed, nor for cattle originating outside of the quarantined district, except when such cattle are intended for immediate slaughter.

JAMES WILSON, *Secretary.*

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